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ABSTRACT

Learning about issues such as natural resources, solid waste management, waste reduction, and the economics of recycling can encourage people to make better choices for the future. This curriculum provides teachers and students with background information and activities relating to four major ecological issues: natural resources, waste management, toxics, and solutions including reduce-reuse-recycle, and compost. Each section is designed in an interdisciplinary format to facilitate cross-curricular involvement. Lessons include: (1) "Resource Research"; (2) "Paper Recycling"; (3) "Compost in the Classroom"; (4) "What is Garbage"; (5) "The Throwaway Three"; (6) "Garbage Math"; (7) "Home Survey"; (8) "San Francisco's Hidden Resources"; (9) "Make a Model Landfill"; (10) "What is Toxic"; (11) "Household Hazardous Wastes"; (12) "Oil and Life Don't Mix"; (13) "The Lethal Dose"; (14) "Changing Habits"; (15) "The Twenty Foot Swath"; (16) "Garbage Free Lunch"; (17) "A Litter Walk"; (18) "Packaging Your Product"; (19) "From Junk to Art"; and (20) "Siting a Waste Indicator." Contains a glossary and a teacher resource section. (JRH)

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Resource Cycles: A Curriculum for Middle & High School Teachers

Office of the Chief Administrative Officer
San Francisco Solid Waste Management Program
1145 Market Street, Suite 401
San Francisco, CA 94103
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The following portions of lessons were adapted or reprinted:

Siting an Incinerator:	Borrowed Time, Environmental Education Associates, Washington, DC 1991.
What Is Toxic and *The Lethal Dose:*	San Francisco Science & Health Education Partnership, San Francisco, CA 1991.
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Packaging Your Product and *A Litter Walk:*	Adapted from "The 4th R", originally distributed in the California Adopt-A-Beach Teacher's Handbook, San Francisco, CA 1989.

Other lessons were adapted from "The 4th R", San Francisco's Recycling Curriculum for Elementary Schools, or are original works of contributors.

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Introduction

Education Makes The Difference

There is a growing recognition that education about our environment is one of the best tools we have to combat its degradation. Learning about such issues as natural resources, solid waste management, waste reduction, and the economics of recycling can encourage all of us to make better choices for the future.

This curriculum provides teachers and students with background information and activities relating to four major ecological issues: Natural resources, waste management, toxics and solutions including reduce-reuse-recycle and compost. Each section is designed in an interdisciplinary format to facilitate cross-curricular involvement.

A Local Perspective

San Francisco residents rely upon many materials from all around the world. Most of what we use on a daily basis comes from outside the City. An enormous quantity of natural resources are used to produce the goods we consume. For example, over seven million trees are cut down every year to produce the paper used by San Franciscans.

The use of these resources produces a lot of waste. We transport over five million pounds of garbage each day to the Altamont landfill in Alameda County. This means San Franciscans generate more than *two billion* pounds of garbage each year! At our present rate of garbage production, our landfill space will be used up within twenty years.

What's more, our population and the amount of solid waste we produce is increasing. Residents of San Francisco pay more than three million dollars per month for the collection and disposal of garbage. Although we are one of the best recycling cities in America, we are still a long way from achieving the state-mandated goal of reducing waste by fifty percent by the year 2000.

You Make A Difference

Each of us plays an important role in reducing waste on the planet. As we learn more about the fragile state of our global environment it is imperative that we practice wise use of natural resources. The first step in this process is a commitment to waste reduction, reuse and recycling in our homes, workplaces and schools.

Background

San Francisco Waste Management Program Background and History

The San Francisco Solid Waste Management Program was established in 1978 under the direction of the Chief Administrative Officer. Its main function is to oversee the management of resources and garbage discarded by residents and businesses of San Francisco. It carries out this function by using an integrated management approach that incorporates waste reduction, reuse, recycling, composting, hazardous waste minimization, and landfilling. The Recycling Program and the Hazardous Waste Management Program are part of the Solid Waste Management Program.

Both a city and a county, San Francisco is 49 square miles in area, with approximately 750,000 residents and a daytime population of over one million. It generates about 1,000,000 tons of waste and valuable resources per year (1990), approximately 35% of which is recycled.

RECYCLING IN SAN FRANCISCO

Recycling services abound in San Francisco. In 1993, more than one-third of the materials discarded in San Francisco were recovered and reused or recycled. These efforts contribute to preserving the environment and reducing garbage disposal costs. San Francisco has earned the reputation of being one of the finest recycling cities in the United States. Our success lies in the diversity of materials recycled and options available for recycling convenience and in the enthusiastic participation of both residents and businesses.

The San Francisco Recycling Program does not run any recycling centers nor collect materials, but rather promotes existing recycling opportunities, supports local recycling efforts, identifies areas where new programs are needed, facilitates their development, and coordinates recycling activities. The following programs are sponsored or supported by the San Francisco Recycling Program.

Commercial Recycling

Approximately 70% of the materials discarded in San Francisco are generated by businesses. Many companies collect a variety of these materials for reuse and recycling. San Francisco's Commercial Recycling staff provide technical support and information to businesses and City government offices starting and expanding recycling programs. "How-To" seminars, recycling guides, desktop recycling containers, waste reduction and buy recycled tips are provided to businesses free of charge. In 1990, businesses participating in recycling efforts set aside 236,000 tons of materials for recycling.

City Government Recycling

The City's 24,000 employees set an example for businesses by recycling office paper and much more. From July 1993 to June 1994, more than 12,000 tons of materials were recycled including office paper, newspaper, glass and aluminum beverage containers,

organic debris, construction materials, scrap metal, antifreeze, motor oil, used linens from hospitals, and wooden pallets. Proceeds from the sale of recycled paper are returned to the City's general fund. The Association for Retarded Citizens assists the City's contractors in these recycling activities. The City is developing programs to emphasize source reduction and the purchase of recycled-content materials. Some of the recycled-content products used by City Government include copy paper, stationery, forms, trash can liners, office supplies, re-refined oil and retreaded tires. An effort to stop the New Year's tradition of tossing old calendars out the window has resulted in a savings to the City in the cost of cleaning up the unnecessary trash and has served to educate other office employees of the need to recycle and reduce waste.

Residential Recycling

Residential curbside recycling began in 1989 under an agreement between the City, Sunset Scavenger Company, and Golden Gate Disposal Company. Residents recycle aluminum cans, glass jars and bottles, plastic soda bottles, tin and steel cans, cereal and other dry food boxes, flattened cardboard, junk mail, magazines, newspapers, office paper, paper bags, and telephone books. The collection companies provide bins and collect the recyclables weekly. West Coast Recycling processes and markets the recyclables. The recycling bin itself is made from at least 20% post-consumer recycled plastic. Apartment buildings are provided with centrally located containers for easy recycling. Participation in the residential curbside and apartment building recycling has been outstanding. About five thousand tons of recyclable materials are currently collected each month and sold to markets in the Bay Area and other parts of California, as well as across the country and overseas.

Community Recycling Centers

Twenty-six privately-operated nonprofit and for profit recycling centers are located throughout San Francisco. Residents and businesses can recycle for money, to support a community group or charity, for environmental reasons, or because it's convenient. The recycling centers accept a variety of materials including mixed and white paper, newspaper, cardboard, junk mail, paper bags, phone books, cereal and other dry food boxes, Christmas trees, magazines, catalogs, wrapping paper, glass jars and bottles, aluminum cans and foil, tin/steel cans, bimetal cans, and PET plastic. Several recycling centers also accept HDPE plastic, clothing, scrap metals, and other goods. The San Francisco Recycling Program promotes the services of these centers through a Recycling Directory and the Recycling Hotline, and provides financial support to centers run by non-profit organizations.

GARBAGE COLLECTION AND DISPOSAL

Garbage collection in San Francisco is governed through an initiative ordinance passed in 1932, which divided the City into 97 routes and granted permits to a number of private companies to pick up garbage on each route. Over the years, garbage companies holding permits have merged and today almost all garbage permits are held by two firms - Golden Gate Disposal Company and Sunset Scavenger - both owned by Norcal Waste Systems. No company may collect solid waste without first obtaining a permit from the City's Department of Public Health. Other haulers may collect construction and demolition debris,

waste paper, or other materials having a commercial value.

Solid waste is delivered to a transfer station run by Sanitary Fill Company, which is owned by the two collection companies' parent company, Norcal. The solid waste is then loaded into large capacity transfer vehicles and hauled to the Altamont Landfill, located in Alameda County, just over 60 miles from San Francisco. Under a contract effective November 1, 1988, the City has the right to dispose of 15 million tons of solid waste or use the landfill for 65 years, whichever comes first. If the City's rate of waste generation remains at its current levels, we will reach the landfill capacity limit in 2014. If the City increases its current diversion levels, we could obtain additional years of disposal capacity.

In 1989, the State of California enacted the California Integrated Waste Management Act (Assembly Bill 939) mandating cities and counties to reduce solid waste disposal 25% by 1995 and 50% by 2000. At our current diversion rate of 35% (1994), we have exceeded the 1995 requirements.

Homeowners, landlords and businesses pay the collection companies directly on a per can basis for garbage collection and disposal. At the transfer station, the haulers then pay a tipping fee. This fee covers the costs for the transfer station, transportation and disposal, solid waste planning, the household hazardous waste facility, and other recycling, solid waste, and hazardous waste programs. Fees charged to residents by the collection companies and the tipping fee are set by the City's Refuse Collection and Disposal Rate Board, which is chaired by the Chief Administrative Officer.

Of the Solid Waste Management Program's yearly budget, 50% is allocated to the Recycling Program, 30% to the Hazardous Waste Program, and the rest is spent on solid waste administration and planning. Funding for the Solid Waste Management Program comes from a fee charged to residents on their garbage bills. This money is deposited by Norcal into the Solid Waste Impound Account, which is used to pay for program obligations and the Solid Waste Management Program.

Organics Recycling

About 27% of San Francisco's waste is organic. In order to reduce the amount of this waste going to the landfill, the San Francisco Recycling Program contracts with the San Francisco League of Urban Gardeners (SLUG) to promote home composting to City residents. SLUG offers home composting workshops, provides lessons and activities on composting to San Francisco schools, distributes brochures, maintains a hotline for composting questions, and manages a subsidized compost bin program (2,650 bins were distributed in 1992 and 1993). The City has completed its 7th year of its Christmas tree recycling program (see Seasonal and Special Projects) and has many plans for future projects including composting for food and yard waste, additional on-site institutional composting, and a wood recovery program.

School Education

The School Education Program was started in 1987 and serves all public and private schools in San Francisco. It focuses on recycling as a way to learn about science concepts and is aligned with the California Science Curriculum Framework. In addition to this curriculum, "The 4th R" has been designed for grades K-5. Teacher workshops, curriculum materials, class presentations, and field trips are also available for teachers and students to learn about waste composition, disposal, recycling, buy recycled, composting, and the "science" of garbage.

Public Education and Information

In addition to the school education program, promotional efforts directed at adults have played a major role in making recycling a success in San Francisco. These include campaigns targeted at specific groups in San Francisco's diverse cultural communities. Most written materials are available in Spanish and Chinese, and recycling advertising is printed in a variety of community and neighborhood newspapers. Media campaigns, including press releases, brochures, ads, posters and flyers, are used to promote seasonal campaigns and programs such as phone book and Christmas tree recycling. The City operates a Recycling Hotline in English, Cantonese and Spanish that includes information for residents and businesses.

Source Reduction/Reuse

The Recycling Program promotes source reduction of waste and reuse by subsidizing several different programs. The Scroungers' Center for Re-usable Art Parts, partially funded by the Recycling Program through grants, collects reusable materials from businesses, industries, and residents to be reused and recycled into creative art projects by school children, other children's programs, social service organizations, and individuals. The Recycling Program distributes "A Guide to Art and Ecology Projects for Teachers", a publication produced by Norcal's Artist-in-Residence program to assist teachers in implementing creative activities to make "treasures from trash". Also, the San Francisco Community Recyclers, a community-based non-profit organization, is investigating the feasibility of collecting and reselling reusable building supplies. This project, if successful, could help valuable materials stay out of the landfill and in the City's economic mainstream.

Seasonal and Special Projects

The Recycling Program started the Christmas "Treecycling" program in 1987. Now, more than 80% of the Christmas trees sold in San Francisco (450 tons in 1993) are collected through curbside and drop off centers and sold to be chipped and used as garden mulch or burned for fuel. The City also works with Pacific Bell Directory to recycle old telephone books. In 1993, 1,100 tons of phone books were collected through curbside and drop-off centers, amounting to 43% of the total number of phone books distributed a year earlier. The Recycling Program assists university and college recycling centers. Campus centers collect paper, aluminum, juice containers, tin/steel and glass. In collaboration with Goodwill, the Recycling Program operated a curbside collection program for clothing and small household goods. In 1992, this program reached 48,000 residents in San Francisco. Grocery stores became involved in an "environmental shopping" campaign, designed to educate shoppers about waste reduction, recyclable packaging, and non-hazardous products. The Recycling Program also funded the production of Sustainable City's "Recycled Products Guide" to encourage San Franciscans to "close the loop" by buying recycled products.

Market Development

In order for recycling to be successful, there needs to be strong markets for the recyclable materials that are collected from residents and businesses. San Francisco's recyclables are shipped to markets all over the world. Thus, the Recycling Program is working to strengthen markets close to home, in other parts of California, as well as across the United States. The Recycling Program is also working with other city departments to buy recycled products. In 1992, the Board of Supervisors adopted a Resource Conservation Ordinance,

which requires city departments to reduce waste and buy recycled products. The list of recycled materials purchased by the City grows each year.

HAZARDOUS WASTE COLLECTION AND CONTROL IN SAN FRANCISCO

Hazardous waste has become a prominent environmental issue. The production, transportation, and disposal of these wastes are just a few of the issues that we are faced with. The primary goal of the San Francisco Hazardous Waste Management Program (HWMP) is to keep hazardous waste out of the San Francisco municipal solid waste stream. The County Hazardous Waste Management Plan (CHWMP), which was authorized by the California Hazardous Waste Management Plans and Facility Siting Procedures Act (Assembly Bill 2498), and developed with public participation, addresses the reduction and management of hazardous materials and wastes to the year 2000. A separate regional committee has developed an allocation formula for future siting of hazardous waste management facilities in the nine counties of the Bay Area. The HWMP is a division of the San Francisco Solid Waste Management Program. The division has the following three programs that address hazardous waste issues in San Francisco.

Household Hazardous Waste Collection Program (HHWCP)

Residents can bring their household hazardous products, such as paint, used motor oil, and insecticides to the Household Hazardous Waste Collection Facility. Usable products, such as paint, unused solvents and insecticides, become a part of the Hazardous Materials Exchange Program, so that others can use them. Recyclable products, such as used motor oil, are collected and re-refined for reuse. The small remainder of hazardous products that cannot be reused or recycled are properly treated or disposed of in a hazardous waste landfill. A hotline (415) 554-4333 operates 24 hours a day to advise residents of the hours and regulations regarding the use of this facility.

The Waste Acceptance Control Program (WACP)

The WACP is a multifaceted effort to prevent hazardous waste from entering the landfill. Wastes entering Norcal's Garbage Transfer Station are carefully observed for any sign of hazardous waste. This hazardous waste is then removed and the responsible party is identified, informed, educated, and if necessary, fined for the illegal disposal. In this way, hazardous waste is removed from the solid waste stream before it reaches the landfill and responsible parties are held accountable for proper disposal. Education programs, information packets, and workshops are produced to educate the public.

Waste Minimization Program

This program is designed to provide options to businesses that produce significant quantities of hazardous wastes. A series of workshops, grants, waste audits, checklists and options are provided to businesses to encourage them to reduce the quantity of hazardous wastes produced. Everything from minor procedural changes to major refitting of equipment is considered in an effort to significantly reduce the amount of toxic waste that is produced at the source.

For more information about the San Francisco Solid Waste Management Program, the Recycling Program, or the Hazardous Waste Management Program, call (415) 554-3400.

Suggested Units From This Curriculum

All of the activities are science-based, and cover at least one science concept. The lessons are designed to work independently of each other, allowing the teacher to use as many as seem appropriate. However, each lesson does have a recommended sequence written beneath the title, so that teachers who wish to develop a unit have some assistance in sequencing.

No specific grade levels have been assigned to these lessons (other than for Middle & High School). The wide range of skills and abilities in San Francisco students are difficult to categorize. Each teacher must decide whether a particular lesson is appropriate for his or her students. The lessons are general enough that they can be easily adapted to meet specific class needs. The Background Section of each lesson was written to be read aloud to the class.

The subject area groupings below will help teachers who teach within a single subject area. However, do not limit yourself to these groupings! Many of the lessons cross all subject areas, making them interesting to the students and assisting teachers in making connections between what may appear to be quite different issues.

Activity	Pg. No.	English	Art	Social Studies	Math	Science
A Litter Walk	117					✓
Changing Habits	101			✓		
Compost In The Classroom	21					✓
From Junk To Art	127		✓			
Garbage Free Lunch	111			✓		✓
Garbage Math	39				✓	✓
Household Hazardous Wastes	77					✓
Home Survey	45	✓		✓	✓	✓
Make A Model Landfill	61					✓
Oil & Life Don't Mix	85					✓
Packaging Your Product	121		✓	✓		
Paper Recycling	17		✓			✓
Resource Research	13	✓		✓		
San Francisco's Hidden Resources	51			✓	✓	
Siting a Waste Incinerator	129			✓		✓
The Lethal Dose	95	✓			✓	✓
The Throwaway Three	31	✓				
The Twenty Foot Swath	105	✓		✓		
What Is Garbage?	25					✓
What Is Toxic?	69	✓				✓

Section 1

Resources, Naturally

Resource Research

Follow up with Paper Recycling or Compost.

Lesson Summary:

Students conduct research and write reports about natural resources, where they are found, and how they are used in our society.

Key Concept:

All living things need natural resources to grow and survive.

Background:

Natural resources are substances that developed during the formation of the earth or were later created by ecosystems. The Earth is rich with a variety of natural resources making it a productive planet. Some resources are required for life on earth; for example, the sun, air, water and minerals. Our society today could not exist without our use of the Earth's large supply of elements and natural resources. However, as human populations grow and societies waste and pollute, we face the danger of running out of or destroying the natural resources we need and depend on to survive.

Procedure:

1. Using the Teacher Information Sheet, decide whether to require written or oral reports; and if written what length: 1, 3, or 5 pages. You may want to break your students into small groups and have them work cooperatively on a subject area. Have each student choose a different question from the work sheet and then combine the answers to make a complete report.

2. Discuss what natural resources are. Distinguish between the products made from natural resources, and the resources themselves. For instance, iron is a natural resource, steel is a product made from natural resources.

3. Hand out the "Resource Research Questions" to your students. Using your "Natural Resources Subject Areas" list, have the students select the subject area each wishes to study. Or assign certain subject areas to groups of students.

Vocabulary:

- ecosystem
- minerals
- natural resources

Materials:

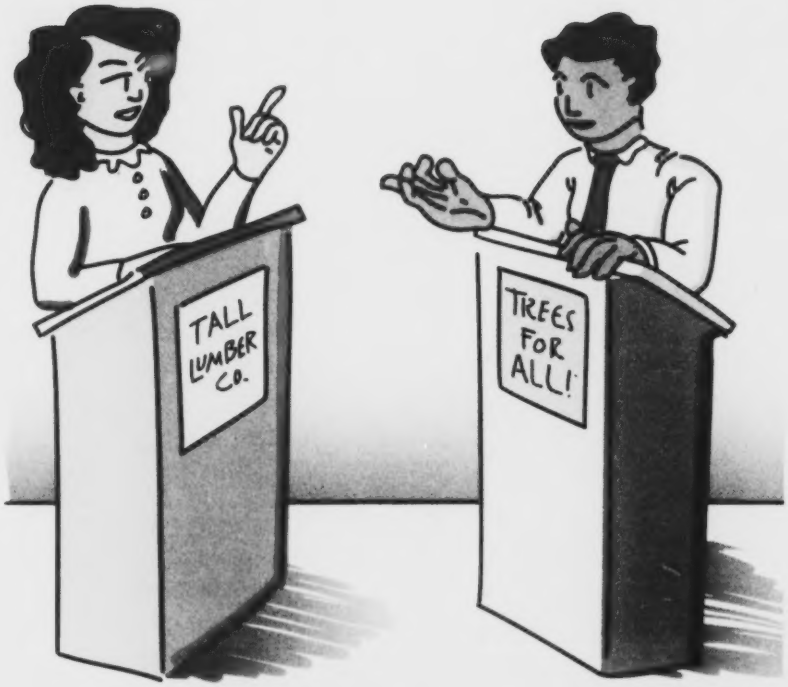
- access to a library and/or encyclopedia
- Teacher Info Sheet, "Natural Resource Subject Areas"
- Student Worksheet, "Resource Research Questions"

4. Give your students adequate time to conduct the research.

5. Have students present their reports to the rest of the class.

Extension:

Invite guest speakers from two organizations that have opposing view points on the use of a particular natural resource. Have students prepare questions and instigate an in-depth discussion. For example, invite an oil company representative and a Sierra Club representative to discuss the extraction and use of petroleum.



Student Worksheet

Resource Research Questions

Resource: _____ **Name:** _____

1. What is it (mineral, etc.) and what is it composed of?

_____

_____

2. Where in the world is the greatest supply?

_____

_____

3. How is it useful to humans?

_____

_____

4. How plentiful is the usable supply?

_____

_____

5. Is it renewable or non-renewable?

_____

_____

6. Is there a known replacement for it?

_____

_____

7. What could happen if we run out of it or destroy it?

_____

_____

8. What happens to the environment where the resource is harvested?

_____

_____

Teacher Info Sheet

Natural Resource Subject Areas

The following list suggests possible resource subject areas your students may want to research:

- sunlight
- wind
- fresh water
- salt water (oceans)
- soil
- oxygen
- nitrogen
- natural gases
- animals
  - wild
  - domestic
- plants
  - trees
    - rain forest species
    - domestic crops
  - petroleum
  - coal
- precious metals
  - gold
  - silver
- copper
- lead
- iron
- bauxite ore
- cadmium
- uranium
- plutonium
- sand
- soda ash
- limestone

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Paper Recycling

Precede with Resource Research, follow up with Packaging Your Product.

Lesson Summary:

Students make new paper or paper products from old paper to understand the recycling process and observe how "waste" paper can be easily made into new paper products.

Key Concept:

The recycling process involves taking a discarded product, like paper, changing its physical or chemical form, and making it into a new product.

Background:

Paper is made of wood (cellulose) fibers which have been pulped, shaped, pressed, and dried. Recycled paper is made by re-pulping old paper and forming it into new paper. Recycling one ton of old paper to make new paper saves 4,100 kilowatt-hours of energy (enough energy to power an average home for six months), saves 7,000 gallons of water, keeps 60 pounds of air pollution out of the atmosphere, saves 3 cubic yards of landfill space, saves 17 trees, and creates additional jobs. Until recently, society has unwisely overlooked the extra cost to our pockets and our environment and has thrown away paper that could be easily recycled.

Some packaging is already made from recycled materials. Look for the three white recycling arrows on a black background and the term "recycled", indicating that recycled materials have been used in the manufacturing or packaging of a product. Many grocery bags, cereal boxes, and shoe boxes are made from recycled paper and paperboard. Three white with black outline arrows on a white background indicate the material is recyclable, meaning that the item may have been made out of virgin paper but is technically recyclable. As yet, there are no national guidelines governing the use of the symbols. The American Forest and Paper Association recommends using the white on black version for recycled and the white with black outline on white version for recyclable, however, the symbols are often switched. The state of California passed an environmental labeling law in 1990 making it illegal for anyone to represent any consumer good as "recycled" or "recyclable" unless the article meets specified definitions. In order to use the symbol or the term "recycled" in California, the product must

This logo means the item is made from recycled materials.

This logo means the item can be recycled.

Vocabulary:

- biodegrade
- cellulose
- disintegrate
- pulp
- recycle

Materials:

- several sheets of one type of paper: newspaper, construction paper, and colored scrap paper. Use approximately one sheet of paper for every student participating.
- several sponges for blotting paper

Continued on next page.

Materials Cont...

- old newspapers or paper towels for blotting
- magnifying glass or microscope to look at paper fibers
- decorations: glitter, flowers, food color, yarn, foil, etc. to add to blender
- samples of home-made paper
- You can check out a kit with all the necessary materials from the San Francisco Recycling Program. Call 584-9706 in advance and reserve a paper making kit.

TO MAKE YOUR OWN PAPER KIT:

- blender
- large container for soaking the paper
- an old wooden picture frame with window screen stretched and stapled over it
- tub (or access to a sink) to catch the water poured through the screen

contain a minimum of 10% post-consumer content. Post-consumer content is material that has been used by consumers, including individuals, organizations, and businesses.

Note: Hand-made paper is a recognized art form. Be sure to do something creative with your finished paper. Make a collage, write a poem, or see Extensions for ways to use your recycled paper.

Procedure:

Practice this procedure ahead of time and save the paper (the good pieces and the mistakes!). Show these samples to your students during the demonstration.

Day one:

1. Set up a paper station a day or two before you plan to do the papermaking activity. Supply the station with magnifying lenses or microscopes and samples of several different types of paper - newspaper, paper towel, construction paper, paper board, egg carton. Have each student use the microscope(s) or magnifying lenses to see the fibers and compare the different types of paper. Describe how paper is made from the cellulose fibers in trees. Discuss the strength and durability of the fibers and that they can be reused many times.

2. Discuss with your students what to make with the new paper - write poems, make masks, stationery, art projects, a collage, bookmarks, etc.

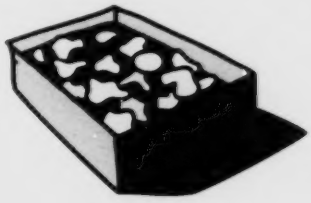
3. Have the class tear paper into 1" strips or into pieces about 1" x 2". Place them in water to soak overnight. Try soaking several different types of paper in separate tubs.

Day two:

Demonstrate the following procedure before letting students begin. You may want to divide the class into groups or partners, and let each group proceed one at a time.

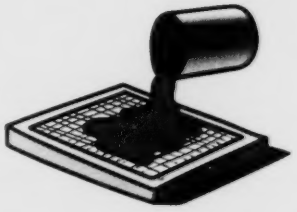
4. Pulp the paper in the blender by putting about 1/2 cup of pre-soaked paper (a small handful) and at least 2 cups of water into the blender. Turn it on and blend for 1 minute. If the paper solution does not easily blend, or seems thick and

clogged, stop the blender immediately and add more water. The pulp should be the consistency of very **thin** soup. If the mixture is too thick, the blender will start to smoke and may break or overheat. Watch carefully to prevent overfilling the blender with paper! Touch the pulpy water and look at the cellulose fibers with a magnifying glass. You can also add decorations to the blender: glitter, bits of yarns (don't get caught on the blades!), food color, leaves, dried flowers, etc.



5. Hold the screen over the pan or sink as you pour the pulp quickly and evenly over the screen. Let the mixture drain. Then place a few dry sheets of newspaper over the screen of pulp and hold it firmly in place. Gently press out the excess water. You now have a 'sandwich' of screen on the bottom, pulp in the middle, and newspaper on top. Lift the screen and turn the 'sandwich' over onto the table with the screen side up and the newspaper blotter side down. Use the sponge to absorb excess moisture by pressing it on the screen.

6. Slowly lift the screen off the pulp. Tapping the screen will help loosen the pulp. The paper pulp should drop off the screen and remain on the newspaper. Lay it on the table pulp side up. Gently sponge off moisture if necessary. Let the pulp dry on newspaper overnight.



Extensions:

For SEED CUPS:

- several paper egg cartons
- muffin tins

Take the wet pulp off of the screen using your hands and form it into the muffin tins, and let it dry. Carefully lift out and use for planting seeds. The sprouted seeds and cups can be planted directly into the ground. Slowly the paper cup will biodegrade, leaving some useful cellulose for the growing sprout.

For MASKS:

- newspaper
- small hairdryer

After making a sheet of paper, drape it gently over the face of a willing student. Mold the wet paper to fit the contours of the face. Let it dry for 20 minutes in the sun or use a blow dryer until paper is dry enough to maintain the shape. Crumple up a ball of newspaper, about the size of the students' head, and lay the damp mask over the ball to retain the face shape. Let it dry overnight.

For ART COLLAGE:

Tear the newly made recycled paper into small pieces and make an art collage or mosaic with glue.

Compost in The Classroom

Follow up with Garbage Free Lunch and Make A Model Landfill.

Lesson Summary:

Students make compost in a cup or bucket in the classroom, a process which takes about two weeks.

Key Concept:

With the help of tiny bacteria and other organisms, all organic matter can be decomposed into a rich soil nutrient we call compost.

Background:

Soil is one of the Earth's most precious natural resources. It is composed of rocks, minerals, and organic matter, which comes from the decomposition of plants and animals. This organic matter is called humus. Soil contains the important minerals and elements necessary for new plants to grow. The soil cycle, the cycle which converts dead plant or animal tissue into a form that can be absorbed by new plants and animals, is essential to all life on Earth. There are tiny microscopic animals in the soil that eat and convert dead tissue into a form that is easily absorbed by plants. These microscopic animals, bacteria, are the most numerous creatures in the world. One handful of soil can contain 5 billion creatures - as many as all the people in the world!

Composting is the process people use to convert organic matter to humus. It can happen anywhere there is sufficient organic matter, moisture, and air to nurture the microscopic bacteria, fungi, and other organisms that decompose organic matter - even in a little cup or a bucket in the classroom.

Procedure:

For A cup of compost:

1. Distribute cups and scissors to each student. Distribute and explain the SLUG handout, "Compost: The Inside Story". Distribute the student work sheets.

2. Have students cut pieces of nylon screen large enough to cover the mouth of the cup and be secured by the rubber band. Distribute one piece of screen and one rubber band to each student.

Vocabulary:

- aerobic
- anaerobic
- bacteria
- compost
- decompose
- humus

Materials:

- SLUG handout, "Compost: The Inside Story" (see Resource Section)
- student Worksheet

FOR A CUP OF COMPOST:

- one cup per student (reusable)
- scissors for each student
- rubber bands for each student
- nylon window screen material (available at hard-

Continued on next page.

Materials cont...

ware stores)
- one gallon of soil additive: compost, soil, sawdust, or potting mix
- plant wastes: grasses, weeds, leaves, paper, fruit or vegetable skins

FOR A BUCKET OF COMPOST:

- five-gallon bucket or larger container with lid
- one gallon of compost, soil, sawdust, or potting mix
- trowel or spade
- non-animal, non-greasy food wastes from school lunches: bread, fruit, vegetables, crackers, etc.

DO NOT USE anything with mayonnaise, peanut butter, butter, or any oily coating.

DO NOT USE meats or milk products. Egg shells are OK.

3. Have each student place about 2 tablespoons of soil in their cup. You can try using different types of soil additives (potting soil, sawdust, compost) to different cups and compare any differences over time.

4. Using scissors, cut up plant wastes into small pieces - the smaller the pieces, the faster the results. Pack loosely into cup.

5. Add a few drops of water and mix cup contents thoroughly so that the soil, organic matter, and water are evenly distributed. Cover with screen and secure with rubber band around rim of cup.

6. Every day or two, stir contents of cup and add water to keep soil moist, but not wet. If the soil is too wet or too dry, the bacteria will not function as efficiently. Record observations on the student work sheets.

7. Organic matter will be nearly all broken down within two to three weeks. Very little should remain except a rich dark brown and fragrant soil nutrient called humus.

8. As you watch your cup contents change from plant matter and a little soil to rich dark nutritious humus, ask your students what they think is happening. What causes the changes? Refer to the SLUG Guide for more information.

For a Bucket of Compost:

1. Add about one quart of soil (compost, potting mix, or sawdust) to the 5 gallon bucket.

2. Have students collect food waste from their school lunches. Include any organic, non-meat, non-oily product. Pieces of bread, orange peels, apple cores, crackers, vegetables and cereals are all fine. You can also add plant matter from around the school: grass clippings, weeds, leaves, etc.

3. With the trowel or spade, chop the food waste and weeds into small pieces. The smaller the pieces, the faster the decomposition.

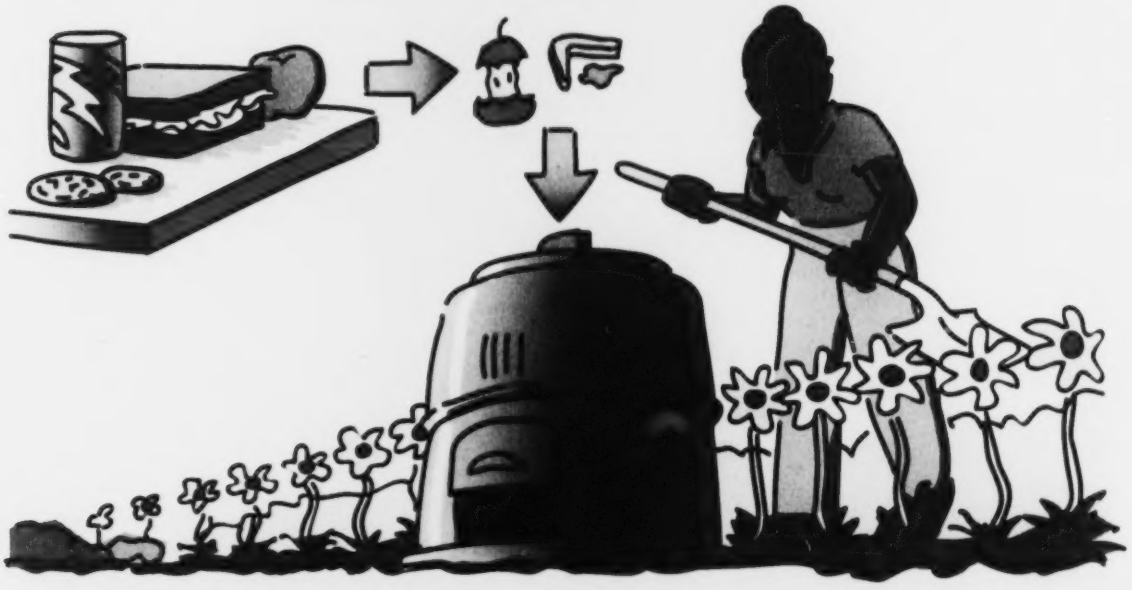
4. Cover the bucket loosely with the lid to allow air to enter, or you can use nylon mesh. Be sure to keep the compost mixture moist, at about the level of a wrung-out sponge.

5. You can keep adding to the compost bucket until it is full. Stir daily to allow air to reach the aerobic bacteria, and keep proper moisture levels. Record observations on the student worksheets. In a few weeks, the food and vegetable matter will have been digested and converted into humus.

6. Be sure to use your humus by mixing it in with soil in a classroom potted plant or by planting seeds into it. You may want to experiment by planting similar plants in two containers, one containing the humus and the other regular potting soil. Have students observe and compare their growth over time.

Extension:

Take your class on a field trip to the Garden For The Environment or have a representative from the San Francisco League of Urban Gardeners (SLUG) visit your class and help you start a compost program for your classroom or the entire school.



Student Worksheet

Compost Data

Title of Experiment: _____ **Name:** _____

Record your observations on the data sheet. Be sure to indicate how many days it has been since the experiment was started. Include observations you can see, smell, and feel.

DAY 1: Briefly describe the experiment. Record any future observations below.

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

24

What is Garbage?

Precede with Resource Research, follow up with Garbage Math and Changing Habits

Lesson Summary:

Students learn that garbage is composed of items made from natural resources. This leads to a discussion of conserving natural resources and improving our wasteful habits.

Key Concept:

Everything we throw away comes from valuable natural resources. Resources are mined or collected at great cost to us and to the environment. These costs make it necessary to give more care and consideration to conservation and reuse of these valuable materials.

Background:

Most of us never think about the composition of our garbage. Garbage is composed of items that are made from natural resources. Aluminum comes from bauxite ore that is mined in Australia, Africa, the Caribbean, and in parts of Central United States. Glass is made from silica, sand, and soda ash. Plastic products are derived from petroleum, and paper comes from trees. Seventy percent of all metals we consume are used once and then put in a landfill. As a result, we are depleting the natural resources on which we depend and have created new problems such as acid run-off from mines, erosion from deforestation, and destruction of habitats.

Procedure:

1. With the class, look at the garbage items collected from the garbage can at home or school. Distribute the worksheet, "Where Did It Come From?"
2. As items are identified, have students record them on their "Where Did It Come From?" worksheets. Have students identify the resources used to make the items. If necessary, use a dictionary or an encyclopedia to find out the resource used to make an item.
3. Discuss with your class what was learned. Can you identify the resource used to make every garbage item collected?

Vocabulary:

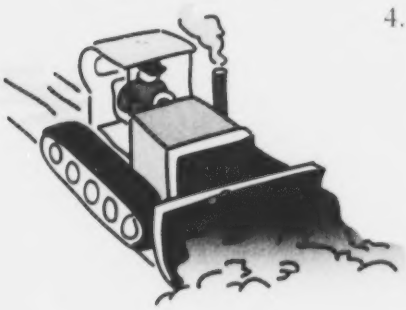
- aluminum
- bauxite
- petroleum
- silica

Materials:

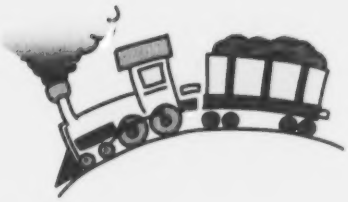
- contents from the classroom garbage can and recycling containers, or garbage items and recyclables brought from home
- Student Worksheet "Where Did It Come From?"

In Resource Section:

- Department of Conservation's "Trivia, Facts, and Other Stuff"
- Resource Data Sheets
- Plastics Info Sheet



4. It should now be clear that everything we throw away comes from a natural resource. Use the Data Sheets (in Resource Section) to illustrate the natural resources we discard each year. Discuss the implications of this. Do we have an infinite supply of natural resources? What if we ran out? How would our lives change? Why do we throw so many things away when we may run out of them eventually? Would it be easy to recover these discarded items after they have been buried in landfills? Who would pay for this cost? Discuss ways to reduce the amount of natural resources being thrown away on national, city, school, and personal levels.

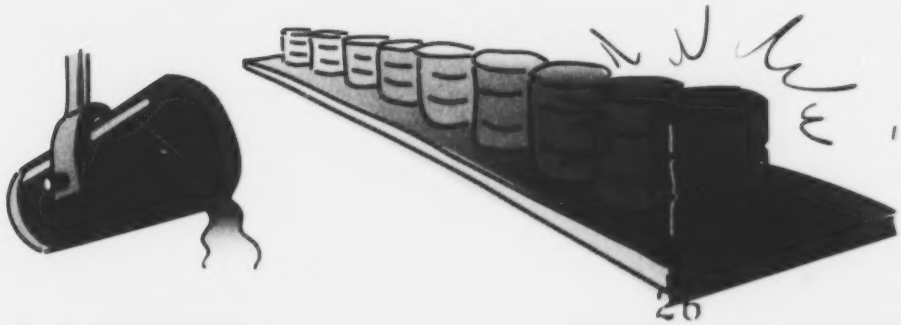


5. Have students write a letter to a local policy maker with the class suggestions on how to reduce waste of natural resources on school, city, or state levels. You may choose to write to a senator, the mayor, the superintendent of schools, or other local officials.

6. Have students pledge to reduce their use of natural resources on a personal level. They can make their own list or use the checklist in lesson 14, "Changing Habits."

Extension:

Discuss the use of other natural resources in the production of the items used for this activity. Include the consumption of natural gas, coal, petroleum or other fuel sources, as well as the water, soil, and air pollution created by mining, logging, or drilling.



Student Worksheet

Where Did It Come From?

Name: _____

List the items from your garbage can. Indicate what material each one is made of. Then indicate the resource that was used to make it. See examples below.

	Items	Materials	Resources
1.	bottle	glass	sand, silica, water, soda ash, fuel
2.	bag paper	trees, water, fuel	
3.	container	PET plastic #1	petroleum, water, fuel
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Section 2

Our Throwaway Society

5

The Throwaway Three

A fun overview. Precede with What is Garbage, follow up with Garbage Math.

Lesson Summary:

Students read aloud the story to learn about and discuss methods of garbage disposal.

Key Concept:

No single method of waste management can effectively process and conserve the many types of materials discarded everyday by San Francisco residents and businesses. However, the right combination of methods can correct our long time habit of "throwing it all away", decrease pollution, and conserve natural resources, including land.

Background:

Waste disposal has not changed much since the beginning of culture. Human societies have always dumped, burned, or buried their garbage. Human beings have also always reused and recycled materials, although some societies have reused and recycled more than others.

In the United States before 1930, garbage collectors were called "scavengers" who sorted all forms of garbage for disposal and reuse. During the war efforts in the 1940s, recycling was considered a matter of necessity and patriotism. Since the 1950s, with increased production of synthetic products, the United States has been the leader in waste production. As the wealthiest country in the world, we use and throw away vast amounts of natural resources. We have begun to realize that we can no longer afford to be so wasteful. We are destroying habitats in the process of using and depleting natural resources. Some natural resources, like tin, are nearly used up. This is not just a problem for the United States, but for all countries in the world. We are also running out of places to bury all our garbage. Some of it is toxic and can potentially cause health problems when disposed.

Finding new ways to solve our garbage problem is not likely. But we can change the emphasis in our old methods. We can place more emphasis on composting, reuse and recycling, and less on burning and landfilling. We can rely less on disposable products and depend more on reusable and less waste products. These methods, called Integrated Waste Management, reflect a new perspective to the age-old issues of resource use and waste disposal.

Vocabulary:

- nomad
- agriculturist
- industrialist
- Integrated Waste Management

Materials:

- "The Throwaway Three" Teacher Info Sheet
- "The Throwaway Three" story, enough copies for all students to read
- a variety of waste items including reusable, recyclable, and compostable items (optional) brought by students from home.

Procedure:

Day one:

1. Instruct each student to bring a waste item from home to school. Try to acquire a variety by suggesting some of the items mentioned in the story, "The Throwaway Three." Examples might include organic materials, plastic items, clothing, aluminum foil, glass bottles, etc.

Day two:

2. Distribute a copy of "The Throwaway Three" story to each student.

3. Have each student read one stanza, so that every student has a turn. As each stanza is read aloud, have each student take his or her garbage item to the front of the class and place it on the growing pile of garbage.

4. After reading the story aloud, discuss the ways we dispose of our garbage (See Teacher Info Sheet). Who were the biggest waste makers in the story? Why? What problems did this wastefulness result in? No single one of these methods alone can effectively handle all waste. Discuss how a combination of waste management practices might successfully conserve resources and habitats, decrease pollution, increase jobs, and change our wasteful habits.

Extension:

Break the students into small groups, rehearse, and have each group perform the poem as a skit. Have the students dress in costumes appropriate to the characters in the story, and perform the skit to the entire school during a lunch break or assembly to encourage participation in a school recycling program.

Teacher Info Sheet

The Throwaway Three

Discuss with your students the various ways waste has been disposed.

Monkey: Threw it down. No problem developed because there was no exceptionally large concentration of primates that stayed in one place, as in cities, and because everything they threw down was organic and biodegraded into compost.

Cave dweller: Threw it, burned it, buried it. No problem developed for the same reasons as for the monkeys.

Algerian: Threw it out. Throwing out garbage began to be a problem because people lived close together in the city. This was resolved by taking the garbage out of the city to a dump.

Briton: Threw it out. As cities became larger, the garbage problem became larger too. Without an official system to collect and remove the garbage from the cities, it would stay and rot in streets, leading to health problems and a horrible stench.

Nomad: Had practically no garbage other than food waste, which was primarily organic and composted.

Agriculturist: Threw it out, burned, and buried it. Livestock helped clean it up by eating organic debris.

Industrialist: By 1900, garbage collection was instituted in US. cities. With the increasing quantities of machine-made goods, much more was generated and thrown out.

Scientist: The discovery and use of synthetic polymers, which do not biodegrade and can produce health problems when burned, have also helped create the garbage disposal problem that we face today.

Native American: Like the cave dweller and the nomad, they used as much of an item as possible, and what they threw away was almost all biodegradable.

Continued on next page.

Teacher Info Sheet

The Throwaway Three (pg.2)

Problems created by a wasteful society

1. Depletion of finite non-renewable natural resources
2. Habitat destruction caused by the extraction and transportation of resources used to make goods
3. Pollution
4. Shortage of landfill space
5. Health problems from unsanitary conditions
6. Extra cost of waste hauling

One solution to the garbage problem is a combination of methods. This approach is called integrated waste management:

1. REDUCE the amount of resources we consume and the garbage we produce
2. REUSE the resources/materials we buy
3. RECYCLE what cannot be reused
4. COMPOST organic matter
5. Put what is left in a LANDFILL
6. INCINERATE with appropriate pollution controls

In California (and in San Francisco) lawmakers have established a hierarchy of "waste" management methods. Source-reduction is the foremost strategy in this hierarchy. Reducing and reusing are the most important methods of waste management to conserve natural resources and habitats. Reducing means, for example, choosing products with minimal packaging. By creating less waste initially, we decrease the amount of waste generated and the need to manage it. Reusing encourages the use of long-lasting products and discourages the use of disposable items. Recycling and composting are next in the hierarchy. Recycling is recommended for items that can no longer be reused. Composting is a way of recycling yard, food and wood scraps into a useful and fertile soil amendment. Putting waste items in a landfill and incineration are last in the hierarchy recommended for items that can no longer be reused or recycled.

Student Info Sheet

The Throwaway Three

Person 1
This is the tale of The Throwaway Three,
Of people and trash throughout his-to-ry.
Now they're very nice people, just like you and me,
Who all have a problem, as you will soon see.
What shall they do with the litter and trash?

All
Why, throw it! Or bury it! Or burn it to ash!

Person 2 - 90,000 BC (monkey)
I represent people when we lived in a tree.
I get rid of trash so easily!
It's a snap! It's no problem – to me or to him.
We just let go – plop! Down through the limbs.

Person 3 - 50,000 BC (Cave Dweller)
I am a cave dweller who lives on the ground.
What do I do with old stuff around?
Why burn it, like meat. Burn it up in the fire;
Or bury it like bones, in the muck and the mire.

All
Why, throw it! Or bury it! Or burn it to ash!
That's how we always get rid of our trash!

Person 4 - 500 BC (Algerian)
I am an Algerian who lives in a town.
Our laws won't allow me to just throw it down.
I have to drag it away for a mile.
And then I can dump it, forget it, and smile!

Person 5 - 1200 AD (British person)
I am British, wary and quick;
Down on our street it can get pretty thick.
When housewives up there want to pitch out their goo,
They just leave it out there and yell: "Gardy -loo!"
(Person 4 yells, "Gardy-loo!")
It will stay there and stay there until the next rain,
Or until our fair London should burn down again.

All
Oh, what do we do with our litter and trash:
We throw it, bury it, or burn it to ash!

Person 6 - 1600 (Nomad)
I am a nomad. I came without much,
Just my family, some animals, a few tools and such.
But everything else I must make with my hands.
So I don't throw out much — I use all I can.

Person 7 - 1700 (Agriculturist)
I am an agriculturist; now life's not so tough.
We have trade between towns that brings lots of stuff,
And some things are made by our townsfolk today.
I could buy a new harness, throw this old one away.
We have pigs and hogs running loose in our street,
If I toss it out there, they'll eat it up neat!

Person 8 - (Another Agriculturist)
Or we might bury it right over there.
Or we might burn it, nobody would care.

All
What are we still doing with our litter and trash?
You guessed it! We throw it away, bury it, or burn it to ash!

Person 9 - 1890 (Industrialist)
I'm the industrial person and new on the scene.
I mass produce goods with my trusty machine.
This sweater, handmade took one week to make.
But now in one hour, I can make eighty-eight.
I can make things so cheaply, you can now afford two,
And throw out twice as much trash as you need to do.

Person 10 - 1950 (Scientist)
I am the scientific person after World War Two.
The war helped us learn how to make things on cue.
When we couldn't get natural stuff to process,
We invented synthetics to replace the rest.

Person 11 - 1960 (Industrialist)
Rayons and nylons, acrylics and plastics
For furniture and clothing, even elastics;
Forget your old woollens and silks and your cotton;
Real wooden toys and washboards are forgotten.

Person 12 (Another Scientist)
Our new stuff will last forever, you see
Even when its worn out to you and to me.
Permanent pressed, pre-sized and pre-shrunk
When dingy and old, it's still permanent "junk".
(Person 1 yells, "junk!)

Person 13 (Another Industrialist)
We make instant menus that come in a pack.
You just boil the food in its own plastic sack,
Or our TV dinner in its tinfoil tray.
It's quick; you don't wash it, just throw it away!

Person 14 (Another Scientist)
We make lots of TV's and clothes dryers too.
Don't ask for a trade-in; you're kidding, aren't you?

Person 15 (Another Industrialist)
Our new cars all change with each model year,
Don't try to repair them, the cost is too dear.
Besides, we don't bother to make last year's parts

For Skylarks, or Novas, or Cougars or Darts!

Person 16 - (Another Scientist)
It's the New Thing that America craves.
So out with the old stuff, away to its graves.

Person 17 - (Another Industrialist)
So what if there are more of us buying goods?
So what if they won't rot away as they should?

Person 18 - (Native American)
Now wait just a minute! You cannot fail
To include us in your historic trash tale.
We Indians lived simply, on prairies, in woods.
We made no high trash piles, nor mass-produced goods.

Person 19 - (Another Native American)
Let us be your critics, show you where you stand;
And tell you just how you're destroying our land.
Your new-fangled goods will not rot away.
When you throw them all down they remain where they lay.

Person 20 - (Another Native American)
Then you say you will bury them deep in the ground.
All your urban trash will make quite a mound!
So then you would burn it, in smoldering masses
And fill up the air with smoke, deadly gases!

Person 21 - (Another Native American)
Oh, all of your answers have faults everywhere.
You'll either ruin the water, the land or the air.
What's more, your resources — your oil and your ore,
Get smaller each year than the year before.
And what's more — this old Earth's not making any more.

Person 22 - (Another Industrialist)
You're right, our resources are shrinking away
While our trash problem grows bigger each day.
We're always converting resources to refuse
Instead of recycling them for reuse!

Person 23 - (Another Scientist)
Oh, stop it! Don't drop it ! We'll think of a way
To reuse that trash, that ball and that tray.
Don't burn it, return it — we'll make something new,
A vase for your mother, some new toys for you.

Person 24 - (Another Scientist)
Don't burn it, carry it — back to the mill
We'll make a new blanket to ward off the chill.

Person 25 - (Another Industrialist)
It's time we progress past the Disposal Age
And make recycling the popular rage!
Our cans and our bottles, newspapers and plastic,
To throw them away is simply bombastic!

Person 26 - (Another Scientist)
Rubber and oil and aluminum foil,
It's wasteful to dump them in water or soil.
We can gather them, melt them, then use them again,
And save our resources. If not now, then when?

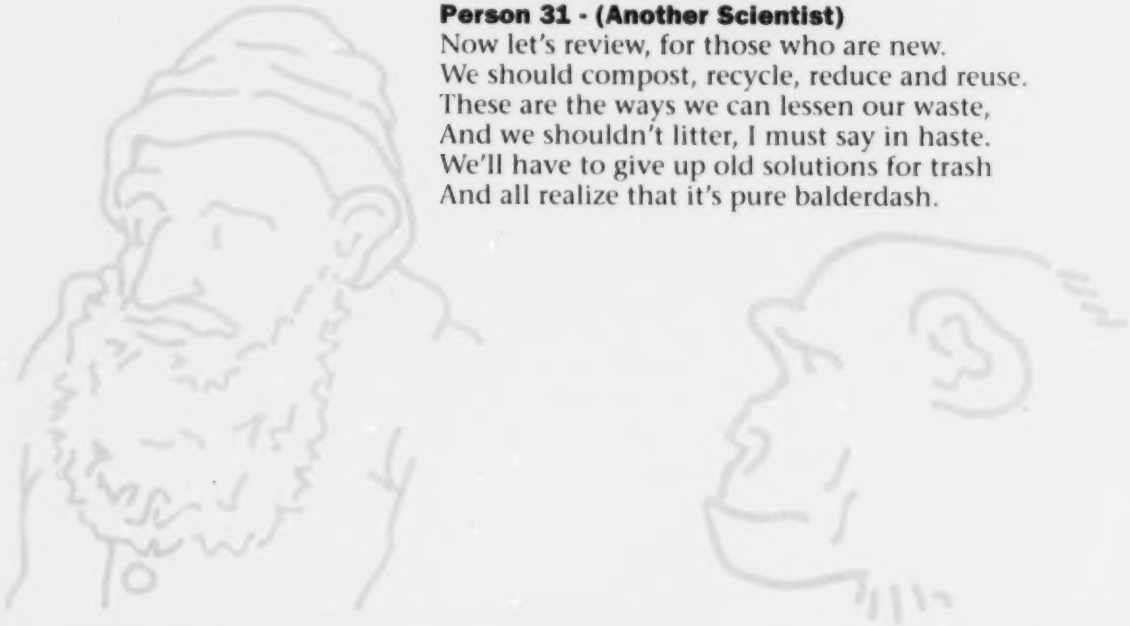
Person 27 - (Another Monkey)
We can compost our fruits and our vegetables too,
Such as rotten potatoes, when they've turned black and blue.
And weeds and grass clippings, dead flowers and leaves,
Banana peels that we can't keep up our sleeves,
We'll put in the yard, and make a big mound,
And next year we'll put it back into the ground.

Person 28 - (Another Industrialist)
But what about reducing the trash we produce?
We can reuse containers that used to hold juice,
And stop buying fast foods and microwave meals.
They just produce trash, and that's not a good deal!

Person 29 - (Another Scientist)
You're right! What insight! Well, now we all see
That to reduce our waste is the primary key!
Now that we know what we all have to do,
We'll tell everyone so they can know, too!

Person 30 - (Another Native American)
Just one more word; I don't mean to sound bitter,
But I've noticed piles and piles of litter—
On sidewalks, on playgrounds, in schools, on the street.
Pick it up please, and make it look neat.
And next time you eat your candy in town,
Think first, and don't throw your food wrappers down!

Person 31 - (Another Scientist)
Now let's review, for those who are new.
We should compost, recycle, reduce and reuse.
These are the ways we can lessen our waste,
And we shouldn't litter, I must say in haste.
We'll have to give up old solutions for trash
And all realize that it's pure balderdash.



6 Garbage Math

Precede with The Throwaway Three, follow up with Home Survey.

Lesson Summary:

Students observe the contents of the garbage can in their classroom and determine its composition. They then categorize the garbage by type and make estimates of total volume, average quantities, weight, and percentages.

Key Concept:

Students appreciate the value of estimation by studying the composition of items in the classroom garbage can.

Background:

Like many 'real life' math problems, garbage production can only be determined in estimates. Each person in the United States produces about four pounds (4.3 in 1990, EPA) of garbage per day. In one year that totals up to approximately one thousand, five hundred pounds (or 3/4 ton) of garbage per person. If each person were to cut his/her garbage production in half, the savings over a lifetime would be an average of 750 pounds per person per year. That would total at least 45,000 pounds of garbage in a lifetime.

An estimate is an approximate calculation. It takes practice to make accurate estimates. This lesson gives students practice in estimating, and provides an opportunity to learn about the amount and type of garbage produced by the class or school.

Procedure:

1. Distribute Garbage Math worksheet. You may want to have only one student record data on one sheet, or break the class into groups and have one recorder for each group. If you have two classroom garbage cans, bring both of them together and have the class gather around to look at them. How full are they? Half-full, one-third full? Record your estimate of the fullness of the can on the Garbage Math Worksheet.

2. Spread a newspaper on a desk or on the floor. Empty the cans on the newspaper and determine the total volume (Volume = width x height x depth) of the empty cans by measuring the height of the can, and its width and depth

Vocabulary:

- approximate
- composition
- estimate
- quantity
- volume
- weight

Materials:

- Garbage Math Student Worksheet
- Garbage graphs (in Resource Section)
- yard stick and ruler
- newspaper to spread on table or floor
- one or two classroom garbage cans (be sure that they have not just been emptied!)
- plastic gloves or plastic bags (optional)

Continued on next page.

Materials cont...

- scale that reads up to 20 pounds, with 1/2 pound accuracy

Aluminum

Glass

Paper

HDPE#2 & PET #1 Plastic

Food Waste

Other Plastic

at the center. If the can is wider at the top than at the bottom, take the top and bottom widths and divide the total by 2 for both width and depth (width and depth will be the same measurement - see Garbage Math Worksheet).

3. Once you have estimated the total volume of the garbage can, you can determine the volume of garbage by using your estimate of the fullness of the can. If the garbage can was 1/2 full, then the volume of garbage is one-half the total volume of the garbage can.

4. Next, categorize the items in the garbage. Look at the items that have been emptied onto the newspaper. Identify and sort them into the following categories: paper, metals and glass, PET #1 plastic, other plastics, food waste, and other materials.

5. Estimate the percentage of volume (space consumed) for each category. Discuss how one item (such as a plastic milk container) can take up so much space, or volume, while paper takes up relatively little volume. Record your estimates on the data sheet. How do your estimates compare to the national percentages for volume or to San Francisco's percentages for volume?

6. Using the scale, weigh each category of items and record these on the data sheet. Add all weights from each category to determine total weight. Record the weight on the data sheet. To determine the percentage by weight, divide the weight of one category by the total garbage weight and record on data sheet. For example, if metals and glass weigh 2 lbs. and the total garbage weight is 5 lbs., divide weight of the metals and glass by the total weight.

7. Count the number of items in each category and record. By counting the number of items in each category and dividing that number by all the items in the garbage can, you can determine the quantitative percentage for each category in your garbage can. Record on data sheet.

8. Discuss your results. How do they compare to the national average? What items took up the most space (volume)? What items were most numerous? Which were the heaviest?

9. All garbage is compacted before going into the landfill. After estimating the garbage volume, predict how much you think compaction would change the volume. Will it affect the weight? Compact the garbage (by stomping on it) and take the measurements for weight and volume again.

10. Now that you know how much garbage you produce in your class, determine how each category can be alternately managed instead of being put in the garbage can and taken to a landfill. Record methods for each category on the data sheet. Emphasize reduction and reuse for volume, weight, and quantity of garbage. For instance, paper used only on one side can be saved for scratch paper or made into note pads. Bottles and cans can be recycled. Some food waste can be composted or fed to a class pet, such as a tortoise or a hamster. Disposable cups can be replaced with reusable cups or mugs. See pg. 42 for items that can be recycled in San Francisco.

11. Choose two (or more) ways to reduce waste in your classroom. Have students monitor reduction progress. Each week or month, increase the number of reduction practices. Set goals and celebrate success!

Extension:

Each day or each week, repeat the first eight steps. Compare your results with the previous test. Have your waste reduction techniques made a difference? Make a chart to show how your class has reduced its garbage by weight, volume, and quantity.

What is Recyclable in San Francisco:

The City accepts the following items for recycling:

- newspaper
- office paper
- paper bags
- magazines
- catalogs
- junk mail
- paper bags
- telephone books
- cereal and dry food boxes
- flattened cardboard
- aluminum
- tin and steel cans
- glass jars and bottles
- plastic bottles PET #1
- HDPE #2 plastic bottles

The City does not accept the following items for recycling:

- waxed or plastic coated cartons (milk cartons)
- mirrors
- paper or boxes lined with foil or plastic (juice boxes)
- light bulbs
- sanitary products or tissue
- Pyrex dishes
- disposable diapers
- drinking glasses
- plastic bags
- carbon paper
- ceramic dishes, cups, etc.
- window panes

For more information about recycling, call the San Francisco Recycling Program at 554-6193.

There are other recycling centers in San Francisco that accept items such as juice boxes and other plastic containers. Call the Recycling Program at 554-3400 for a "San Francisco Recycling Centers Guide".

The City Household Hazardous Waste Collection Facility accepts the following items and more:

- motor oil
- paint
- cleaning products
- insecticides
- steel aerosol cans
- batteries

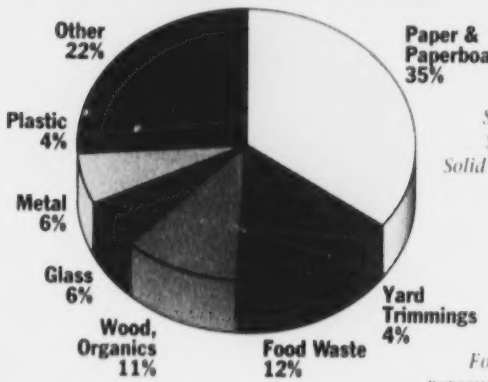
Call the Household Hazardous Waste Hotline at 554-4333 for more information.

Student Worksheet

Garbage Math

Name: _____

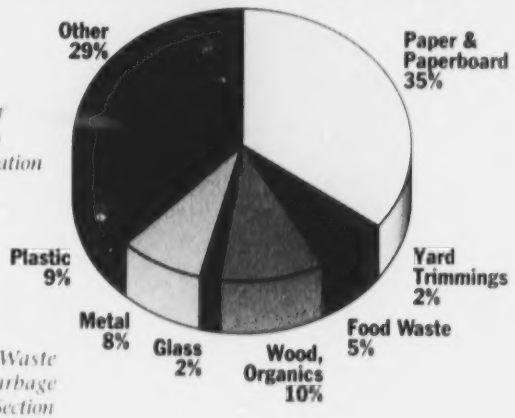
San Francisco Waste by Weight



Source: City of San Francisco Solid Waste Generation Study, 1990

For National Waste percentages see Garbage Graphs in Resource Section

San Francisco Waste by Volume



What Is YOUR Garbage Made Of?

Estimate the volume, weight, and quantity of garbage in your classroom garbage can.

1. VOLUME	**GARBAGE CAN**
1A. About how full is it?	_____
1B. What is total volume of the garbage can?	_____
1C. Estimate of garbage volume?	_____

2. PERCENT VOLUME	
2A. Estimate percent paper	_____
2B. Estimate percent metals and glass	_____
2C. Estimate percent plastic 2 liter soda bottles(PET, #1)	_____
2D. Estimate percent of other plastics	_____
2E. Estimate percent food waste	_____
2F. Estimate percent of other materials	_____
2G. Total percent	_____

Note:

Volume = area x height
or
width x depth x height.

For cylinders:
Volume = πR^2 x height.

Please remember that if you have a container with different sized base and top, then you will need to take the average to get an accurate width.

3. WEIGHT		PERCENT WEIGHT
3A. Weight of paper	_____	_____
3B. Weight of metals and glass	_____	_____
3C. Weight of plastic soda bottles (PET, #1)	_____	_____
3D. Weight of other plastics	_____	_____
3E. Weight of food wastes	_____	_____
3F. Weight of other materials	_____	_____
3G. Total weight	_____	_____

4. QUANTITY		PERCENT QUANTITY
4A. Pieces of paper	_____	_____
4B. Pieces of metal and glass	_____	_____
4C. Pieces of plastic soda bottles (PET #1)	_____	_____
4D. Pieces of other plastic	_____	_____
4E. Pieces of food wastes	_____	_____
4F. Pieces of other materials	_____	_____
4G. Total number of items	_____	_____

5. TOTALS

5A. What item took up the most volume? _____

5B. What item weighed the most? _____

5C. Which category had the most items? _____

6. ALTERNATE MANAGEMENT METHOD(S) AVAILABLE

6A. Paper _____

6B. Metal and glass _____

6C. Plastic soda bottles (PET #1) _____

6D. Other plastics _____

6E. Food wastes _____

6F. Other materials:

_____ _____

_____ _____

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7 Home Survey

Precede with The Throwaway Three follow up with The Garbage of San Francisco and Changing Habits

Lesson Summary:

Students keep a tally of what they throw away at home for six days. The results of the survey are displayed on a bar graph to illustrate the most commonly thrown away items.

Key Concept:

Many people are unaware of the quantity of materials they throw away every day and how much of it is reusable and recyclable in San Francisco. By becoming more aware of what and how much is thrown away, students can make educated decisions about their own "throw-away" habits.

Background:

Most landfills in California will close before the year 2020. San Francisco faces the same fate by the year 2014 if the Altamont landfill cannot be expanded and we continue to produce garbage at our current rate of approximately five pounds per person per day (5 pounds in 1990, Norcal Waste Systems and the San Francisco City Planning Department). The national average per person per day is 4.3 pounds. San Francisco's average is higher due to a significant number of workers who commute to San Francisco every day, the high number of tourists who visit, and to the fact that urban areas tend to produce more construction debris.

Recycling and careful reuse of materials will cut down the garbage disposed of by households considerably. This benefits people who pay for garbage disposal by reducing the number of garbage cans per household. It benefits the entire city as it reduces the quantity of garbage being sent to the landfill, prolongs the length of time it takes the landfill to reach maximum capacity, and delays costs associated with finding and using a new landfill. Recycling and reusing also benefit our society by reducing our need for natural resources and reducing air, water, and land pollution. It also reduces the need to turn new open lands into landfills and to build the infrastructure, such as roads, upon which they depend.

To illustrate the savings from recycling, have half your students include recyclables in their garbage tally, and the other half not include them. The Home Survey Sheet can be used to record data for up to six days.

Vocabulary:

- compost
- disposable
- garbage
- landfill
- litter
- packaging
- recycle
- reuse

Materials:

- at home: two trash containers, one for wet garbage and food waste, one for the rest
- plastic gloves (optional)
- Home Survey Sheet
- Letter to Parents

Procedure:

1. Discuss with your class the problems of resource depletion and habitat problems we face today and the rising cost of garbage disposal. Have they noticed that recycling reduces their garbage? By how much?

2. Distribute the Home Survey Sheet to each student. Have each student keep a record of all the items his or her family throws away each day. The best way to do this is for students to have two separate household garbage containers that are big enough to hold one day's waste. Mark one container for all wet garbage and food leftovers. Mark the other container for all other items which are discarded (paper, cans, glass bottles, jars, mail, bags, etc.). At the end of each day, students count the items thrown out and marks them in the appropriate categories on the Home Survey Sheet. Then the items can be discarded in the family garbage can or recycling bin, leaving the two separate containers empty for the next day's garbage.

   FOOD ITEMS: Do not count every scrap of food thrown away. For instance, if a bowl of old salad is thrown out, count the whole bowl as one ITEM, an entire of plate of food counts as one item, a single piece of fruit is one item and so on.

3. At the end of six days, students tally up the number of items found in each category in their Home Survey. Students bring their tally sheets back to class on Monday for discussion.

4. On the chalkboard, list the total number of items counted in each category. Draw a bar graph to show the results more clearly.

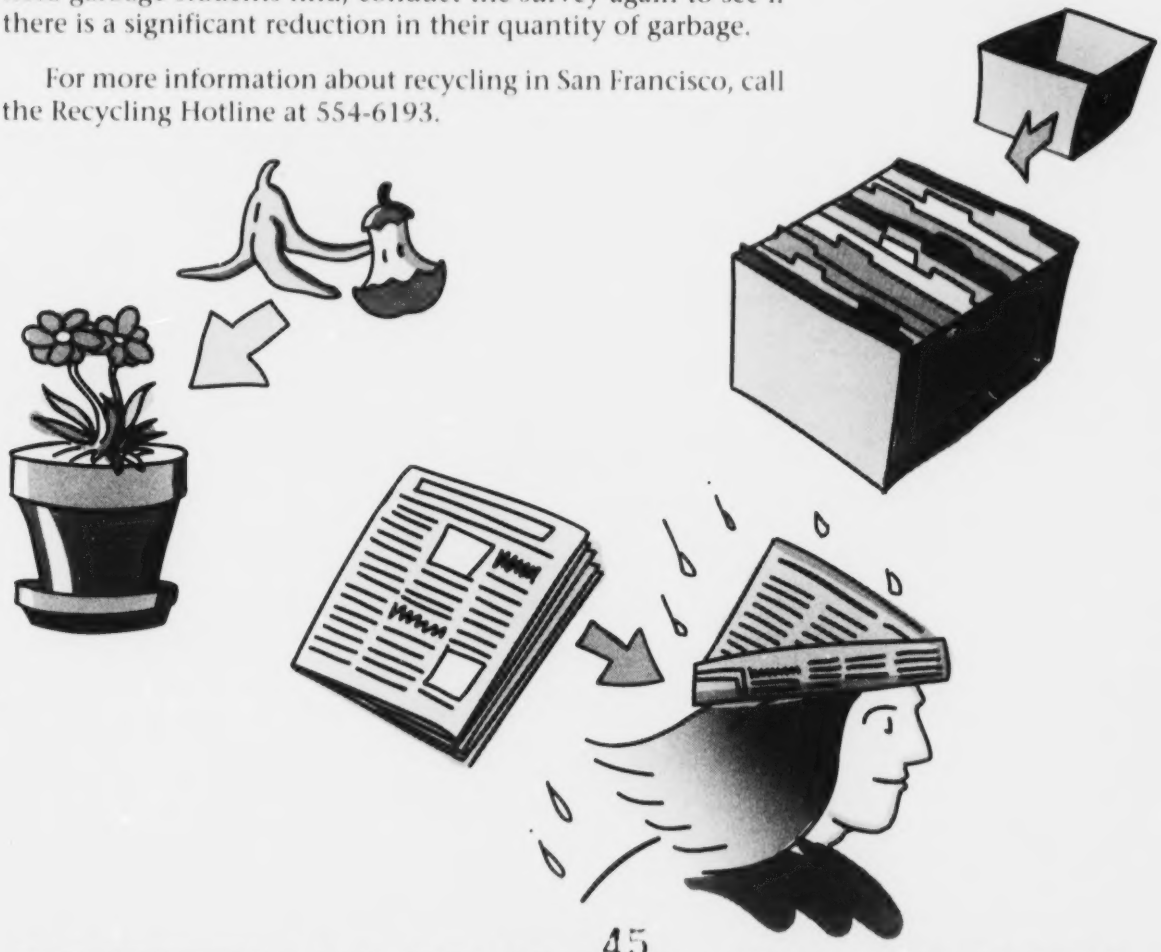
5. Determine which categories had the most items, which had the least. Paper makes up the largest part of most people's garbage. Does your Home Survey indicate paper and paper products as a large part of your garbage also? What came in second and third? Ask students if they were surprised by the results. Did they realize they produced this much garbage? Has this survey made them more aware of what they throw away?

6. Discuss ways to reduce the amount of items in the garbage. Recycling is one way. Other types of items can be saved for reuse. Did students find themselves removing things from the garbage or saving them for some future use? Discuss some possible uses for items found in the trash. Soup cans can be used to hold pencils, boxes are good for storage, paper can be used in art projects, food waste can be composted, and plastic containers can be reused for food storage.

Extension:

After determining ways of reducing the quantity of household garbage students find, conduct the survey again to see if there is a significant reduction in their quantity of garbage.

For more information about recycling in San Francisco, call the Recycling Hotline at 554-6193.



Name: _____

Date: _____

Dear Parents:

In Room_____, we have been studying recycling as a part of our science curriculum. As you may know, the wasteful habits of our "throw away" society are depleting valuable natural resources and creating habitat destruction. We are rapidly filling in valuable landfill space. These problems can be solved in part by developing awareness, reducing the amount of garbage we produce, and by recycling.

The homework assignment for this week will help students identify what actually gets thrown away at home and to learn that a large percent of it may be recyclable. Students will keep a record of all items his or her family throws away over a six day period.

This can be a messy assignment. Here are suggestions for a safe and enjoyable assignment:

1. Use two separate garbage containers that are big enough to hold one day's waste. Use one container for wet garbage and food remains, and the other for dry items.
2. Use cloth or rubber gloves.
3. Take time to supervise your child as he/she completes the assignment.
4. Be on the look-out for tops of cans and other sharp objects that can cause injury.
5. Spread the garbage out on plastic bags that have been split open for easier clean-up and keep wet garbage separate from the rest.

Thank you for your cooperation. We hope this will be an educational activity for the whole family. Please remember to recycle. If you would like more information about recycling services for your house or apartment, call 330-CURB.

Sincerely,

Teacher

Student Worksheet

Home Survey

Date: _____ **Name:** _____

Keep track of every item your family throws away for six days. At the end of the week, total up the number of items thrown away. On another sheet of paper you may add items not listed here.

	Plastic Soda Bottles	Other Plastics	Cardboard	Other Paper	Metal	Wood	Glass	Fabric	Food
Monday									
Tuesday									
Wednesday									
Thursday									
Friday									
Saturday									
Sunday									
Total									

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San Francisco's Hidden Resources

Precede with The Throwaway Three or Home Survey, follow up with a visit to the transfer station.

Lesson Summary:

Students learn how garbage and recyclables are collected in San Francisco.

Key Concept:

Garbage collection is an important part of everyone's life.

Background:

See Handout "San Francisco's Waste Stream"

Procedure:

1. Distribute the handout, "San Francisco's Waste Stream" and assign as a reading assignment.

2. Trace the path of garbage as shown on the "The Garbage Un-Cycle": Home/School ▶ Garbage Can ▶ Garbage Truck ▶ Transfer Station ▶ Landfill. Discuss how to reduce the amount of garbage going to the landfill. First consider reducing the amount of garbage each person produces daily, then find the steps on "The Garbage Un-Cycle" where products could be removed from the "Garbage UnCycle" and recycled instead. Using your pencil, draw arrows on the "The Garbage Un-Cycle" worksheet and write down which materials can be removed from the waste stream at each step.

3. Answer the questions on the "Waste" test. All the answers are in the "San Francisco's Waste Stream" handout. Discuss with your class the various ways to reduce the amount of waste San Francisco disposes in the landfill – by reducing, reusing, recycling, and composting. Are they familiar with all of these methods? What can be done to reduce hazardous waste? What non-toxic substitutes can you come up with? See the Background section of this curriculum for more information.

Vocabulary:

- hazardous
- landfill
- scrap
- transfer station
- waste stream

Materials:

- "San Francisco's Waste Stream" Info Sheet
- "The Garbage Un-Cycle" worksheet
- "The Garbage Un-Cycle" answer sheet
- "The Garbage of San Francisco" test

Extension:

Take your class on a trip to Norcal's garbage transfer station and recycling center to see this operation first hand.

For field trip information call the San Francisco Recycling Program at 554-3400.

Student Info Sheet

San Francisco's Waste Stream

Garbage Disposal

San Francisco is surrounded by water on three sides, and has little space to bury the approximately 2,700 tons of garbage produced here every day. Each resident, tourist, and day worker in San Francisco produces an average of 5 pounds of garbage per day, including industrial and commercial waste (5 pounds in 1990, Norcal Waste Systems and San Francisco City Planning Department). Garbage is continually being created, transferred and disposed of, much like a continually moving stream of water. That is why it is called a *waste stream.*

Garbage is collected from homes and businesses by Sunset Scavenger Company and Golden Gate Disposal Company and then taken to the Sanitary Fill Company's Garbage Transfer Station near Candlestick Park. The collection trucks dump the garbage into a pit where it is transferred into larger trucks that haul the refuse to the Altamont landfill, 62 miles to the east of San Francisco at Altamont Pass. Some materials are pulled out of special loads and recovered. Scrap metal from discarded appliances and construction sites are collected, sorted, and delivered to different metal vendors in the Bay Area. Scrap wood is chipped and burned as fuel in industrial mills.

Residential Recycling

The glass, aluminum, steel, and PET plastic containers collected from the blue curbside recycling and larger apartment bins are processed at the West Coast Recycling's Total Urban Recovery Facility (T.U.R.F.). Paper, such as newspaper, junk mail, magazines, cereal boxes, copy paper, phone books, and cardboard are sorted and baled to be made into other types of paper and boxes. There is also a Household Hazardous Waste Facility for San Francisco residents to bring their household hazardous products such as used motor oil, paint and paint thinner, insecticides, and industrial cleaners. Most of these are recycled or reused. The rest are properly packed and disposed of in a hazardous waste landfill.

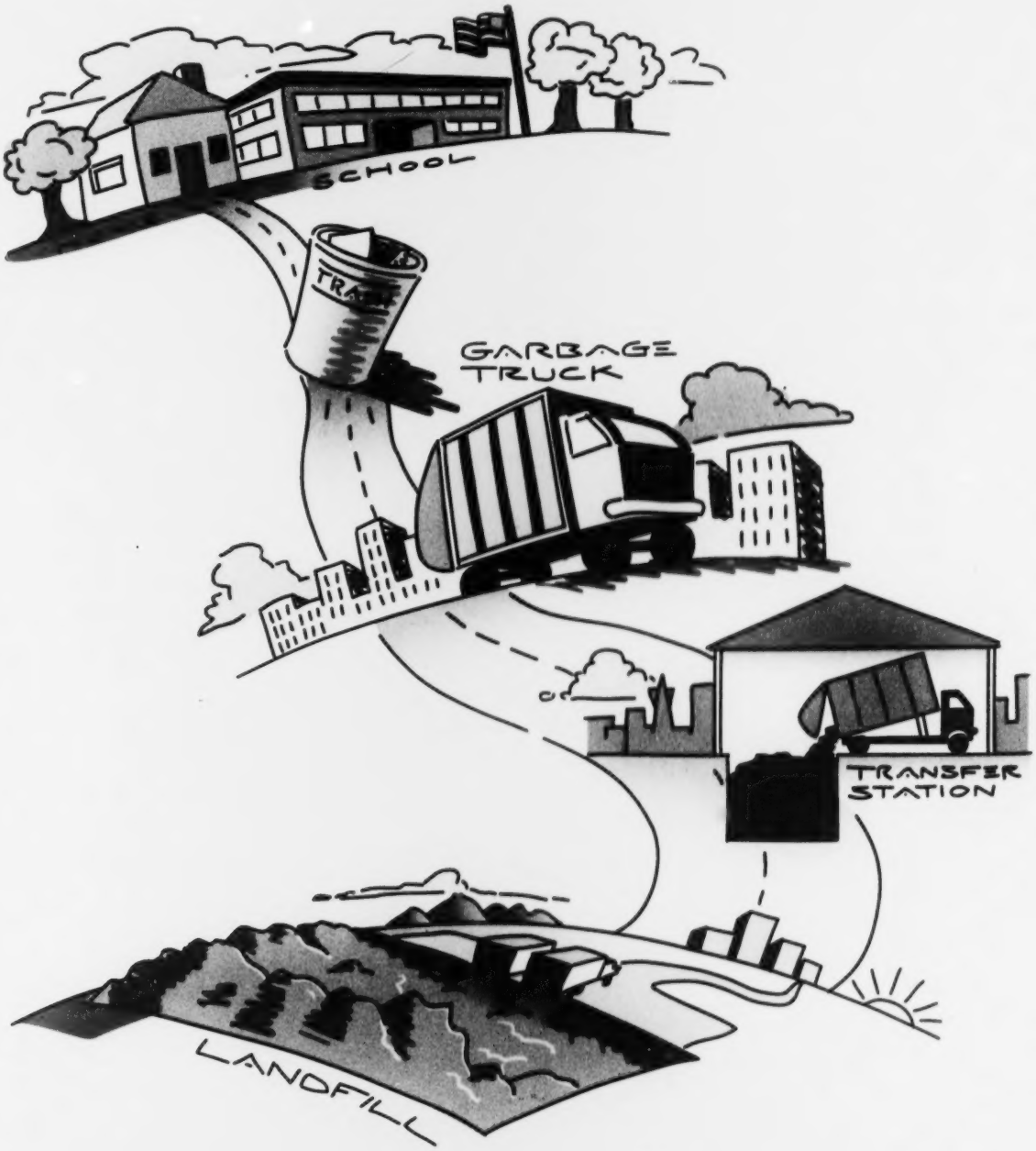
Drop-off and Buyback Centers

There are also approximately 25 recycling buy-back centers located throughout the City where people can redeem their glass bottles, aluminum cans, and plastic soda bottles for money. These centers vary in hours of operation and items they accept. For instance, Richmond Environmental Action (REA) accepts aseptic packaging such as juice boxes and milk cartons. For a list of recycling centers, call the City's Recycling Program at 554-3400.

Student Worksheet

The Garbage Un-Cycle

Indicate where recyclables can be removed from the waste stream by using arrows and listing items.



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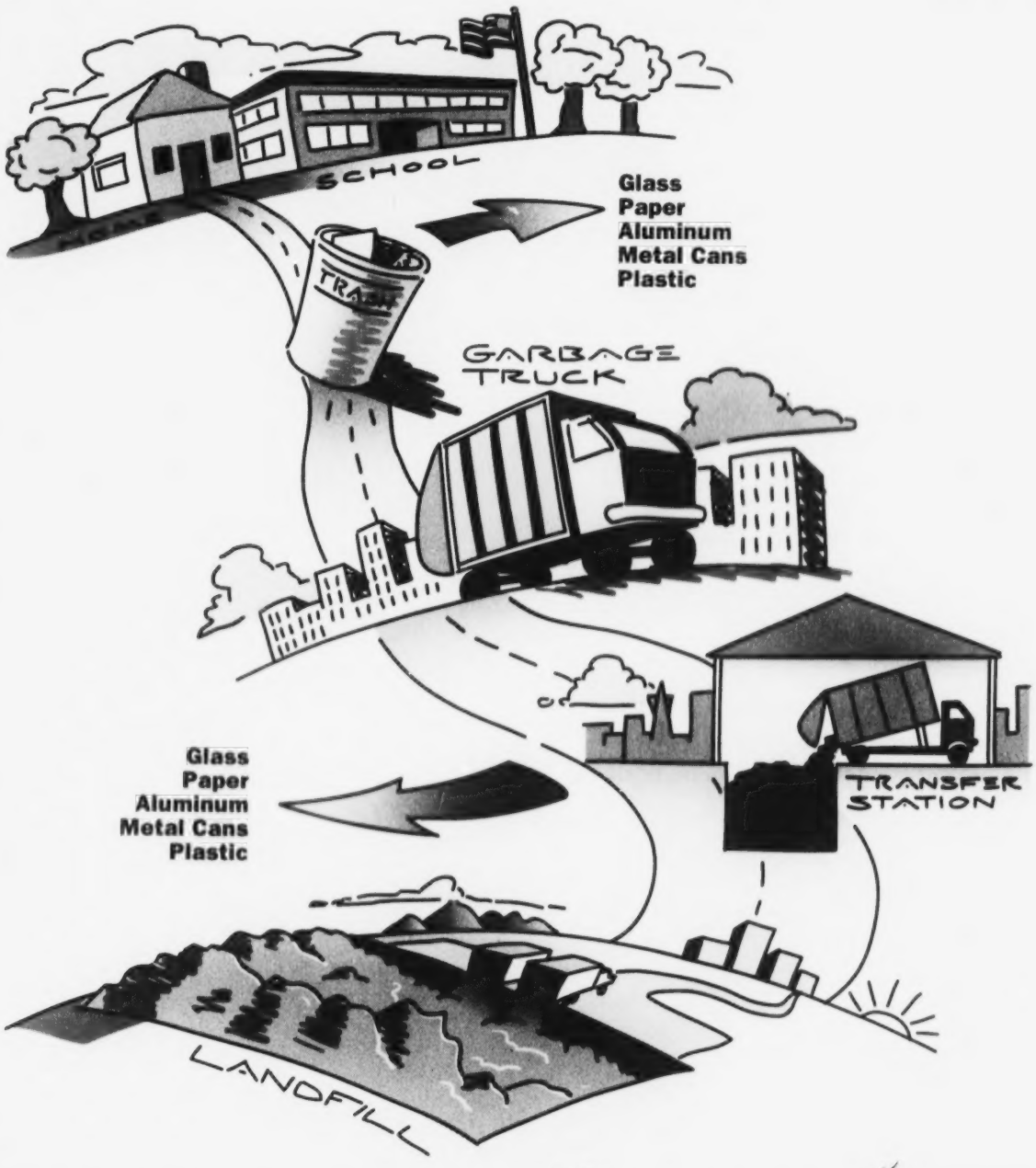
Teacher Answer Sheet

The Garbage Un-Cycle

Arrows are indicated where recyclables can be removed from the waste stream.



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Teacher Answer Sheet

The Waste Test

Page 1 **Name:** _____

FACT: San Francisco produces approximately 5 pounds per resident, day worker, and tourist, adding up to about 2,700 tons of garbage every day (1990). Of that, approximately 950 tons are recycled, leaving about 1,750 tons of garbage going to Altamont landfill every day. Of this, residents create about 30% of total waste and pay $3,000,000 per month for collection and disposal of garbage! At our current rate of garbage production, San Francisco will fill up its landfill capacity by the year 2014 (San Francisco Solid Waste Management Program).

QUESTION: How many pounds are in 1,750 tons?

Answer: 3,500,000 lbs.

QUESTION: Using the facts above, how much garbage does your entire class produce?

Answer: Number of pounds X number of students

In one day? _____

In one week? _____

In one year? _____

QUESTION: Approximately 44% of what residents throw away is paper. About another 10% is bottles and cans. If residents recycled 100% of their bottles, cans, and paper, by approximately how much would we reduce our garbage each year?

Answer: 54%

QUESTION: Name two types of household hazardous waste collected at the Household Hazardous Waste Collection Facility.

Answer: Nail polish, nail polish remover, used motor oil, paint and paint thinner, pesticides and kitchen, bathroom and automotive cleaners.

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Student Worksheet

The Waste Test

Page 1 **Name:** _____

FACT: San Francisco produces approximately 5 pounds per resident, day worker, and tourist, adding up to about 2,700 tons of garbage every day (1990). Of that, approximately 950 tons are recycled, leaving about 1,750 tons of garbage going to Altamont landfill every day. Of this, residents create about 30% of total waste and pay $3,000,000 per month for collection and disposal of garbage! At our current rate of garbage production, San Francisco will fill up its landfill capacity by the year 2014 (San Francisco Solid Waste Management Program).

QUESTION: How many pounds are in 1,750 tons?

QUESTION: Using the facts above, how much garbage does your entire class produce:

In one day? _____

In one week? _____

In one year? _____

QUESTION: Approximately 44% of what residents throw away is paper. About another 10% is bottles and cans. If residents recycled 100% of their bottles, cans and paper, by approximately how much would we reduce what we waste each year?

QUESTION: Name two types of household hazardous waste collected at the House hold Hazardous Waste Collection Facility.

Teacher Answer Sheet

Waste Test

Page 2 The Garbage of San Francisco

Correct definitions are directly across from each word or phrase.

1.	Altamont	place where San Francisco's landfill is located
2.	5 pounds	average amount of garbage produced per person per day in San Francisco
3.	garbage transfer station	where garbage is sorted, compacted, and transferred to the trucks that will haul it to the landfill
4.	blue curbside and apartment bins	San Francisco's residential collection containers for bottles and cans
5.	conserves landfill space	one benefit of recycling
6.	waste stream	ongoing flow of garbage
7.	used motor oil	hazardous waste
8.	compost	recycles yard waste
9.	T.U.R.F.	Total Urban Recycling Facility, where San Francisco's residential recyclables are sorted, processed for resale and marketed

Student Worksheet

Waste Test

Page 2 The Garbage of San Francisco

Match the words in column A to the definition in Column B

Column A	Column B
1. blue curbside and apartment bins	place where San Francisco's landfill is located
2. conserves landfill space	average amount of garbage produced per person per day in San Francisco
3. Altamont	where garbage is sorted, compacted, and transferred to the trucks that will haul it to the landfill
4. 5 pounds	San Francisco's residential collection containers for bottles and cans
5. T.U.R.F.	one benefit of recycling
6. garbage transfer station	ongoing flow of garbage
7. compost	hazardous waste
8. used motor oil	recycles yard waste
9. waste stream	Total Urban Recycling Facility, where San Francisco's residential recyclables are sorted, processed for resale and marketed

Make a Model Landfill

Precede with The Garbage of San Francisco or Compost in The Classroom

Lesson Summary:

Students make a model landfill to replicate and observe what happens in a real landfill. The model landfill process takes approximately three weeks to one month.

Key Concept:

A variety of things happen in a modern sanitary landfill, but complete decomposition of organic matter is not one of them.

Background:

The landfill is the most common form of waste disposal in our country. Jean Vincenz was responsible for developing and implementing sanitary landfills in the United States while he served as commissioner of public work in Fresno, California between the years of 1931 and 1941. He opened the first sanitary landfill in Fresno on October 15, 1934. It was considered different from an open dump because a layer of dirt was placed over the pile of mixed wastes each day, thus reducing problems of vermin, spontaneous fires, odors, and pollution. (Sicular, Daniel. *Currents in the Waste Stream: A History of Refuse Management and Resource Recovery in America, 1981.)*

Today's landfill benefits from many technological advances, including careful attention to finding an appropriate site, installation of a clay or plastic liner to protect ground water, and collection and treatment of the liquid runoff, called leachate. In addition, some landfills have a system that collects the methane gas that is a byproduct of the garbage decomposition and burns it to produce electricity.

Many people still believe that garbage biodegrades into soil when placed in a sanitary landfill. This is not true. While garbage near the surface of a landfill does biodegrade to some degree, garbage that is buried under thousands of tons of other garbage biodegrades much more slowly. The reason for this is that aerobic bacteria, which consume organic matter more quickly and cause decomposition, cannot exist without oxygen, moisture, and sunlight. These bacteria can only survive near the surface of a landfill. Anaerobic bacteria do not need oxygen and can therefore survive deep down in a landfill. These bacteria metabolize matter at a much slower rate and release methane gas in the process.

Vocabulary:

- aerobic
- anaerobic
- biodegrade
- decompose
- landfill
- leachate
- methane

Materials:

- illustration "Sanitary Landfill"
- Student Worksheet
- an old aquarium with a large rock at one end
- 2 pieces of plywood that fit in the aquarium
- soil (enough to fill aquarium)
- a variety of garbage, including metals, glass, wood, food items, plastic, and paper
- watering can with sprinkle spout
- plastic tarp or sheet

Procedure:

1. Show the illustration of a Sanitary Landfill. Identify various parts of a landfill to the students, including the impermeable liner, the compacted trash area, the leachate collection system, the methane venting system, and the ground water running below the landfill. Read the Background Section of this lesson to the class. Distribute worksheets to the class.

2. To build your landfill model, first place the rock in the aquarium and one piece of wood over it, so that the wood sits at an angle. This is so that the leachate can collect on the bottom of the aquarium and be observed.

3. Place a layer of mixed garbage on the piece of wood. Be sure to include: some tightly rolled up newspaper, pieces of carrot, metal, glass, plastic, wood, and anything else of interest. Cover evenly with about one inch of soil and press firmly. Lightly water the soil (to represent rain). Cover with the other piece of wood.

4. Repeat Step 3, including a large variety of garbage items, every day until the aquarium is full. Keep it covered for three weeks, or as long as you want. Water lightly every other day or so. Be sure to press soil firmly and keep it covered with the wood.

5. Observe what changes occur in the aquarium. Students should notice a slightly sulfurous odor. Dark liquid should form on the bottom of the aquarium. Do they notice a change in items they can see through the glass? Is anything obviously decomposing?

6. After three weeks, take the aquarium outside and pour it out onto a plastic tarp or sheet. Be sure to save some of the leachate. Pour this into a bowl and allow all the water to evaporate. Record a description of what is left.

7. On the worksheets, observe which objects decomposed and which did not. Objects made of glass, metal, plastic and wood did not decompose at all. The inner pages of the tightly wrapped newspaper are still readable. The

carrot may have retained much of its color and texture. What items did decompose? Probably some food parts, some paper, or other organic items. What about the smell?

Extension:

This activity works especially well in conjunction with Compost In Your Classroom. A good activity would be to have students record their observations and compare the results of the two experiments. Look at condition of recyclables in the landfill. Would we want to try and recover recyclables from mixed garbage, or should we try to separate them before they're disposed?

Student Worksheet

Make a Model Landfill

Name: _____

Record your observations on the worksheet. Be sure to indicate how many days it has been since the experiment was started that you are making your observations. Include observations you can see, smell, and feel.

DAY 1: Briefly describe the experiment. Record any future observations below.

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

DAY ___

Sanitary Landfill

BEST COPY AVAILABLE

Section 3
The Toxic Reality

63

What is Toxic?

Use as an Introduction to other toxics lessons.

Lesson Summary:

Students learn the definitions of words associated with toxics.

Key Concept:

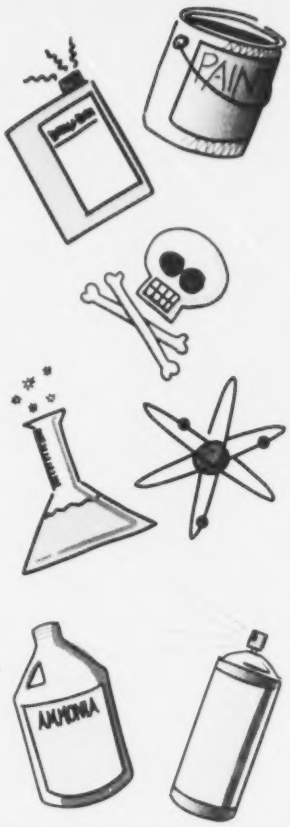
Some everyday household products can cause serious health problems or death to living things and can poison the environment.

Background:

Products that are used in households have contained what we now know as hazardous materials or toxic ingredients from the earliest times. Kerosene was widely used for lighting in the 19th century. Oil-based paints containing lead and arsenic pigments and turpentine thinners were used by Renaissance artists in the 16th century. Chlorine bleaches have been used and manufactured since the 1800s. With the development of the chemical industry in the 19th century, new products were developed which proved superior in their effects when compared to earlier ones. For example, detergents replaced soaps since they didn't clog sewer systems, didn't spoil in storage, and most importantly, didn't leave a soapy residue on clothes after repeated washings. Chlorine disinfectants reduced the spread of infection, and caustic cleaners saved household workers from hours of scrubbing.

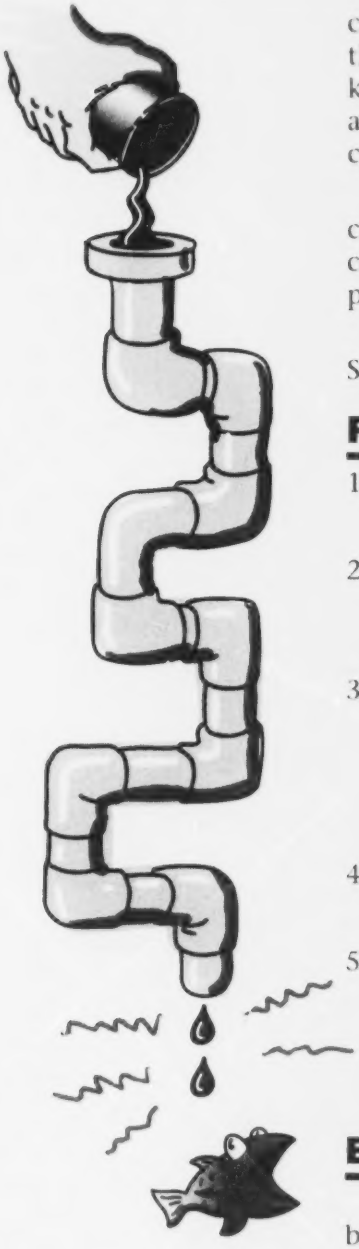
The widespread use of these products have, however, some disadvantages. Modern households contain such common place items as chlorine bleach, oil-based paints, chlorinated stain removers, paint thinners and strippers, toilet cleaners, motor oil, and gasoline for power tools. During and after use, humans are disposing of significant quantities of these products in garbage and sewage systems. When hazardous products are thrown away with our garbage, they can pollute ground water and contaminate our drinking water. When hazardous products containing heavy metals are flushed down the toilet, poured into sinks, or dumped in storm drains, the metals bypass the sewage treatment processes and end up being discharged into the San Francisco Bay and Pacific Ocean. Heavy metals are toxic to fish and other marine life, birds, and mammals.

Since the 1980s, concern for hazardous wastes in homes has increased. Congress has recognized the significant danger of



Materials:

- "What Is Wrong With Toxics?" Info Sheet
- Toxic Word Search Glossary
- Toxic Word Search
- containers or labels of: air freshener, carpet cleaner, mothballs, nail polish, nail polish remover, and oven cleaner



concentrated amounts of household hazardous wastes (HHW) in the waste stream. New programs have sprung up in most cities to keep household hazardous wastes out of our landfills and water, and to dispose of them properly, either by neutralizing them, recycling them, or placing them in a hazardous waste landfill.

Most people do not know what a toxic substance is or how it can affect our health. This lesson provides an overview to the most common household hazardous words, and works best when accompanied by the lesson, Hazardous Waste Home Audit.

For more information on household hazardous wastes, call San Francisco's Hazardous Waste Hotline at (415) 554-4333.

Procedure:

1. Hand out the Toxic Word Search as a classroom activity or a homework assignment.
2. Ask your students what the words in the Toxic Word Search mean. How many words are familiar? Can they define them orally for the class?
3. Divide the class into seven groups. Assign each group a household product or container label. Have them research the ingredients and determine which are toxic and by using the "What Is Wrong With Toxics?" Info Sheet and the Toxic Word Glossary.
4. Have each group present its product to the rest of the class and explain how and why the product is toxic.
5. Initiate a class discussion. Did your students know these items are toxic, or the seriousness of their effects on people? Discuss the students' feelings about these common toxic household products. What do they think should be done to address this issue?

Extension:

Have students report on toxics in the home or on what is being done on a federal, state, or local level to address this problem.

NOTE: This lesson is designed to be used with the Household Hazardous Waste Audit as a follow up lesson.

Student Info Sheet

Toxic Word Search Glossary

Carcinogen - Any material that causes the development and growth of cancerous cells in living tissues.

Caution - When seen on a product package, this word indicates that it contains a slightly toxic substance, and that ingestion of one ounce or more is lethal to humans.

Compressed Gas - A gas stored under pressure. Examples are oxygen and acetylene stored in steel cylinders.

Corrosive - A corrosive material is an acidic or caustic substance that can destroy metals or tissues. Corrosives will burn eyes or skin.

Danger - When seen on a product package, this word represents a high level of toxicity with a lethal dose being a few drops.

Dioxins - Part of a family of chlorinated chemicals, toxic under certain exposure and dosage conditions, emitted from several types of industry, including plastic and some paper processes. Incinerators release dioxins during episodes of inefficient combustion of carbon compounds.

Dose - A measured amount of a material, can be used at one time or over a period of time.

Explosives - Materials designed to produce an explosion, such as for demolition or for military uses. They are substances that decompose rapidly and produce shock waves. A chemical explosive is a substance which explodes spontaneously or as a result of friction, impact, or heat. Examples are dynamite, TNT, and nitroglycerin.

Extrapolation - A projection from known data into an area that is less known so that a reasonable conjecture can be made. For example, scientists may extrapolate that a material that is toxic to rats might also be toxic to humans.

Flammable Material - Any solid, liquid, vapor, or gas that will ignite easily and burn rapidly. Examples include gasoline and hydrogen.

Hazardous Material - Material, including some chemicals, that can cause injury, death, or harm to the environment. Some of the characteristic categories of hazardous materials are:

(a) Toxic - poisonous,
(b) Explosive - can suddenly and loudly release violent energy or explode,
(c) Corrosive - destroys metal or flesh,
(d) Flammable - readily combustible with or without flame,
(e) Infectious - carriers of diseases, and
(f) Radioactive - emits radiation.

Some hazardous materials fall into only one of the above characteristic categories while others fall into several.

Continued on next page.

Toxics Glossary (cont.)

Hazardous Waste - A waste with any of the characteristics of toxicity, reactivity, corrosivity, flammability, infectiousness, or radioactivity.

Infectious Material - A material carrying a type of microorganism, bacteria, mold, parasite, or virus which can cause illness or death.

Lethal dose - The dose of a toxic substance that causes death.

Oxidizers - Materials that often produce oxygen and can cause the rapid burning of normally non-combustible materials. Oxidizers are used in the bleaching of fabrics, chlorination of water, and in fireworks. Examples include chlorine bleach, fertilizers (ammonium nitrate), and hydrogen peroxide (disinfectant).

Poisonous Material - Any material that causes harm or death to living things.

Reactive Material - Materials that react with water violently, generate toxic gases or vapors, or are considered explosive if heated or ignited under confinement.

Toxic - Materials that are poisonous or lethal when ingested, touched, or inhaled even in small quantities.

Toxicity - The level of toxic materials in a substance that causes harm or death to a living organism.

Warning - When seen on a product package, this word represents a moderately toxic substance.

This glossary was compiled by Lowell Miller, 1992, San Francisco Solid Waste Management Program.

Student Info Sheet

What is Wrong With Toxics?

The following household products have ingredients in them that are considered toxic. Each has a warning label describing the toxicity of their ingredients. Although the ingredients are usually diluted, misuse of these products by skin contact, inhalation of vapors, use in a closed room, or ingestion can cause toxic effects. Here is what could happen in those situations.

AIR FRESHENERS

May contain cresol, phenol, and formaldehyde which are toxic in skin contact, irritate the eyes and mucous membranes, and may cause damage to major organs such as the kidneys, liver and pancreas.

Air fresheners are used to desensitize nasal passages so that odors are less noticeable.

ANTIFREEZE

Antifreeze is made of mostly water and ethylene glycol. Ethylene is sweet-tasting, but dangerous. When ingested, it can cause depression followed by respiratory and cardiac failure, renal and brain damage. Antifreeze is especially attractive to animals including pets!

CARPET & UPHOLSTERY CLEANERS

May contain dangerous dry cleaning chemicals such as perchloroethylene. Exposure can cause headaches, nausea, vomiting, hallucinations, convulsions and damage to major organs.

MOTHBALLS

P-dichlorobenzene or napthalene may cause headaches, vomiting, changes in lungs and respiration, and permanent liver damage.

MOTOR OIL

Used motor oil contains hydrocarbons and heavy metals, such as lead, copper, zinc chromium and polychorinated byphenyls (PCBs), and is toxic even in minute concentrations. Consider this, one quart of oil can pollute 250,000 gallons of drinking water!

NAIL POLISH

Contains toluene which when inhaled can cause hallucinations, and other narcotic effects in addition to eye and skin irritation. Longer exposure can result in suppression of the central nervous system and coma. Long term exposure can lead to anemia, leukemia, or other disease of the bone marrow. Also contains ethyl acetate which may poison by inhalation. In high concentrations, ethyl acetate can cause congestion of the liver and kidneys.

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What is Wrong With Toxics? (cont.)

NAIL POLISH REMOVER

Acetone, a solvent which when inhaled may cause changes in brain waves, changes in carbohydrate metabolism, headache, nausea, vomiting and muscle weakness.

OVEN AND TOILET CLEANERS

If these products can dissolve baked on spills, greases, and clear clogged toilets, imagine what they can do to your skin or eyes. Their main ingredient is lye, or sodium hydroxide, a corrosive that can cause permanent damage to eyes or lungs. Some toilet cleaners contain sulfuric acid, an acid that can cause severe burns and tissue damage.

PAINT

Paints can contain several hundred chemicals and carcinogens, including ethylene, which may cause headaches, dizziness, and loss of consciousness. Brightly colored paints contain toxic heavy metals such as lead, cadmium (cadmium yellow and red), manganese, chromium, and antimony. Also some paints contain mercury compounds, which can irritate the skin and mucous membranes.

PESTICIDES

Inert ingredients often make up 90 to 99% of a pesticide (they are not listed on the label and are generally considered trade secrets). Inerts can include the well known carcinogens methylene chloride and benzene. Nausea, dizziness, and headaches can result from pest control sprays such as roach killers, and ant and flea sprays. Pesticides can also cause cancer, arthritis, and nervous system disorder.

Information in "What Is Wrong With Toxics" was taken from *"Your Guide To Less Toxic Shopping"*, 1994, San Francisco Hazardous Waste Management Program.

Student Worksheet

Toxic Word Search

Name: _____

G C A R C I N O G E N B L E
W A R N I N G B T E O L S X
D G C G C O R R O S I V E P
K U C E N M S E I W M P R L
C O N S U M E R I J C E M O
P N O T I N F E C T I O U S
X F L A P R N I T S E G N I
C L E T H A L D O S E E L V
H A Z A R D O U S W A S T E
E M N B A E I K N X A I E R
M M C O S R A O T O N V W P
I A B C I F E H S P S N B V
C B B E S T N U I I O I T L
A L U J H M U I D E N M O Z
L E F R S Q V A N C E S J P
S B R A D I O A C T I V E E

WORDS:

Carcinogen
Caution
Chemicals
Consumer
Corrosive
Dioxins
Explosive
Flammable
Hazardous Waste
Infectious
Ingest
Lethal Dose
Poison
Radioactive
Toxic
Warning

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Teacher Answer Sheet

Toxic Word Search

G **C A R C I N O G E N** B L **E**
W A R N I N G B **T** E O L S **X**
D G C G **C O R R O S I V E P**
K U C E N M S E **X** W M P R **L**
C O N S U M E R I J C E M **O**
P N O T **I N F E C T I O U S**
X **F** L A P R N I **T S E G N I**
C L E T H A L D O S E E L **V**
H A Z A R D O U S W A S T E
E M N B A E **I** K **N** X A I E R
M M C **O** S R A **O** T **O** N V W P
I A B C **I** F E H **X** P **S** N B V
C B B E S **T** N U I **I** O **I** T L
A L U J H M **U** I D E **N** M **O** Z
L E F R S Q V **A** N C E **S** J **P**
S B **R A D I O A C T I V E** E

*some words are backwards and/or diagonal

WORDS:

Carcinogen
Caution
Chemicals
Consumer
Corrosive
Dioxins
Explosive
Flammable
Infectious
Ingest
Hazardous Waste
Lethal Dose
Poison
Radioactive
Toxic
Warning

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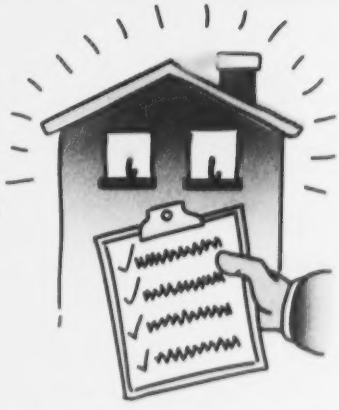
11 Household Hazardous Wastes

Precede with What Is Wrong With Toxics?, follow up with other toxics lessons.

Lesson Summary:

Students conduct an audit of hazardous household products found in their homes and consider non-toxic alternatives.



Key Concept:

Hazardous household products can be replaced with non-toxic and/or less-toxic alternatives. Become aware of the toxic products your family uses, and after using them bring them to the Household Hazardous Waste Facility.

Background:

Today more and more of our household products contain complex chemicals that are hazardous, or become hazardous when mixed with other products. These include such commonplace items as chlorine bleach, nail polish, carpet cleaner, oven cleaner, and used motor oil. We are disposing more of these products than ever before in our garbage and sewage systems. When hazardous products are thrown away with our garbage they can injure garbage workers. They may also pollute ground water and contaminate drinking water after being put in a landfill. Modern landfills are lined with several layers of clay and/or plastic to create a barrier between the garbage and surrounding ground water, soil, etc. Sometimes, however, the linings crack or become damaged and hazardous waste may seep past the lining and contaminate the surrounding areas. When hazardous products containing heavy metals are flushed down the toilet, poured into sinks, or dumped in storm drains, the metals are not effectively filtered in the sewage treatment processes and are discharged into the San Francisco Bay and Pacific Ocean. Heavy metals are toxic to birds, mammals, fish and other marine life.

Misusing these items may cause health problems from just one application, particularly for sensitive individuals. Repeated exposure to moth balls has been shown to cause liver damage in small children. Air freshener actually desensitizes the nasal passages. Acetone, a common ingredient in nail polish remover, is one of the strongest solvents available in hardware stores. Most people are not aware of these everyday hazards or famil-

Vocabulary:

- caution
- corrosive
- danger
- explosive
- flammable
- poison
- radioactive
- warning

Materials:

- San Francisco's Guide To Household Hazardous Wastes, "Garbage Cans, Garbage Can'ts" (in Resource Section)
- San Francisco's Water Pollution Prevention Program brochure, "Water Pollution Begins in Your Home!" (in Resource Section)

Continued on next page.

Materials Cont...

- "HHW Home Audit" worksheet and Info Sheet
- letter to parents
- "Safe Alternatives" worksheet
- several examples of toxic household products: oven cleaner, motor oil, paint thinner, nail polish remover, hair spray (See, "What Is Wrong With Toxics?" lesson for more information)

iar with non-toxic alternatives that are sometimes as easy and inexpensive to use as their toxic counterparts.

The San Francisco Hazardous Waste Program has a broad spectrum of information available about household hazardous waste (HHW), its proper disposal, and safe alternatives.

Procedure:

DAY ONE:

1. Bring examples to class of hazardous substances listed in "Garbage Cans, Garbage Can'ts". Common HHW include paint, motor oil, insect spray and oven cleaner. You may also want to bring in non-toxic cleaners and products for comparison. Look for warning labels on the containers and discuss what they mean.

2. Distribute copies of the "Garbage Cans, Garbage Can'ts", "HW Home Audit", and parent letters to students and discuss the various categories in the audit. Where are they most likely to find HHW's? (laundry room, bathroom, and garage) Suggest that they conduct their home audit with a parent or other adult.

DAY TWO:

3. Discuss the results of the Home Audit. What products containing hazardous substances did the students find in their homes?

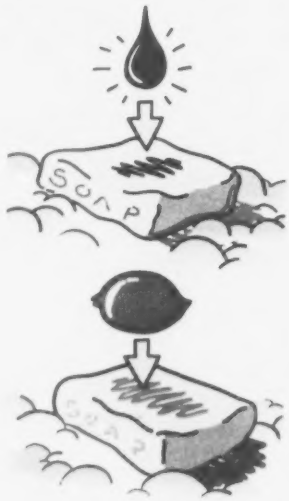
4. Using Garbage Cans and Can'ts, discuss some alternatives to toxic products. There are also non-toxic products available that are not listed. A non-toxic product is commonly labeled "Safe, Non-Toxic" or "Biodegradable". Suggest that your students bring these to class if they found them in their homes. Discuss the alternatives and weigh their benefits with their disadvantages. For instance, using olive oil and lemon juice to polish furniture is less toxic than commercial furniture polishes, however, they require more rubbing and buffing. Do the health benefits outweigh the convenience? (For more information on alternatives to toxics, order a copy of "Your Guide to Less Toxic Shopping" by calling 554-4333).

5. Discuss the fact that not all products are replaceable. For instance, oil-based paint may be necessary for a particular project, but should be replaced by water based paint when possible. On the other hand, some items are unnecessary and can be avoided completely. For example, air can be freshened by opening the windows or by boiling cinnamon. Mothballs can be replaced with cedar blocks. Pressurized aerosol containers can be replaced with pump sprays.

6. Test some of the non-toxic alternatives in the guide to see if they work as effectively as the toxic products. For instance, wash hands with a vegetable or citrus-based soap instead of a petroleum based one. Try using salt and lemon juice to clean brass and copper or vinegar and water to clean windows. Some non-toxic cleaners require more work to achieve the same effect as a toxic one. Ask your students if they think it is worth the extra work to avoid using hazardous chemicals.

7. Have students use the "Safe Alternatives" worksheet to write down five hazardous products they currently use in their home that they can replace with non-toxic alternatives. For instance, use vinegar and baking soda to clear grease-clogged drains instead of toilet cleaners, powder bleach instead of liquid chlorine bleach, and have sewer lines rooted out instead of using root killers, etc.

8. Use the "Water Pollution Begins in Your Home!" brochure. Have students find and identify the activities that contribute to pollution of the San Francisco Bay and Pacific Ocean.



Extension:

Have students write to the manufacturers of products requesting information on the hazardous materials content of the product. This information is available on Material Safety Data Sheets (MSDS), is public, and must be made available upon request.

Name: _____

Date: _____

Dear Parents:

In Room _____, we have been studying hazardous waste as part of our science curriculum. Your child has been assigned to conduct a hazardous waste home audit. Using the "Garbage Cans and Garbage Can'ts" publication and the "Hazardous Waste Home Audit" sheet, your child will search for hazardous products in your home, record hazardous ingredients, record where they were found, and make a decision about proper disposal methods. Proper disposal methods are described in the "Household Hazardous Waste Home Audit " sheet. Please supervise your child during this activity.

The following safety precautions are advised:

1) Use gloves when handling items.

2) Keep pets out of area.

3) Watch younger children closely when items are out of storage.

4) After activity is finished, move items out of reach of younger children.

Thank you for your cooperation. We hope this will be an educational activity for the whole family. Please note alternatives to hazardous products listed in the "Garbage Cans, Garbage Can'ts", and the address of the Household Hazardous Waste Collection Facility. If you have any questions, please call the Household Hazardous Waste Hotline at 554-4333.

Sincerely,

Teacher

Student Info Sheet

Hazardous Waste Home Audit

Name: _____

Disposal Methods for Household Hazardous Waste:

Most containers can be disposed of safely in the garbage if the product inside has been completely used up. Do not pour toxic products down the drain. If you no longer need a product that is labeled as hazardous, do one of the following three things:

1. Use it up completely and throw the empty dry container in the garbage.

2. Give it to someone who will use it up. You may not need it, but someone else may.

3. Bring it to the San Francisco Household Hazardous Waste Collection Facility (HHWCF) for free (or your local hazardous waste collection facility). Hazardous products that can be reused are given away. Many household hazardous wastes such as motor oil and paint are recycled. The wastes that cannot be reused or recycled are properly disposed of in a hazardous waste landfill or incinerator.

San Francisco's HHWCF is located at:
501 Tunnel Avenue near Candlestick Park
The hours of operation are Thursday, Friday, and Saturday
from 8 a.m. to 4 p.m.
Phone number: (415)554-4333

Name: _____

Certain chemicals found in household products are hazardous to living things and to the environment. Below is a list of products that I will stop using and replace with safe non-toxic alternatives.

Student Worksheet

Home Audit

Use this list to find the HHW's in your home. Most toxic substances are found in the bathroom, laundry area, under the kitchen sink, and in the garage. If you suspect a substance is hazardous, read the label.

Product	Brand Name	Type of Hazard	Where Found	Disposal Method (1,2,3)
Aerosol Can				
Antifreeze				
Cleaners w/chlorine				
Cleaners w/petroleum				
Drain Cleaner				
Furniture polish				
Glue-certain types				
Insecticides				
Liquor				
Motor Oil				
Nail Polish				
Nail Polish Remover				
Oven Cleaner				
Paint				
Paint Thinner				
Rat Poison				
Rubbing Alcohol				
Smoke Detector				
Other(s)				

Student Worksheet

Safe Alteratives

	Product	Alternative
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

12 Oil and Life Don't Mix

Precede with Resources Research, use with other toxics lessons.

Lesson Summary:

Students conduct three experiments to observe the effects of oil on soil, water, and plants. They record their observations on worksheets and present a brief report on their results.

Key Concept:

Oil and other petroleum by-products are toxic. They are harmful to living things. If oil is taken out of its natural environment below the surface of the earth for use, and then spilled on land or in water, it is hazardous to living things and difficult to remove.

BACKGROUND:

See "Oil Is Toxic" Student Info Sheet (pgs. 90-91).

Procedure:

1. Distribute the "Oil Is Toxic!" handout to be read in class or as a homework assignment.

2. Divide class into three groups and have each conduct one experiment and then rotate, or conduct each experiment consecutively with the entire class.

Experiment #1

Oil and Plants - Pour 1/8 cup of oil onto the soil of the small potted plant around the roots. Water regularly. Using worksheet #1, record observations. The plant will wither and die. Insect pests may infest it as it loses its defenses. Continue observations for at least one week or longer.

Please note: Experiment #1 takes at least one week to complete.

Experiment #2

Oil and Soil - Put one cup of soil into an aluminum pie plate or dish. Pour 1/4 cup of oil over the soil in the dish. Pour in water until the dish is full. What does the water look like? Pour off the water. Using the detergent and any of the tools found in the Clean Up Kit, try to remove the oil from the soil. Record observations on worksheet #2.

Vocabulary:

- absorbent
- adsorbent
- crude
- hazardous
- petroleum
- refined
- renewable
- resource
- toxic

Materials:

- "Oil is Toxic!" Info Sheet
- worksheets # 1,2, and 3

For lab experiments:

- aluminum pie plates or similar dishes

Continued on next page.

Materials Cont...

- 1-2 gallon tub
- 1 cup vegetable oil colored with one teaspoon of paprika
- eye droppers
- water
- 1-2 cups of soil
- small plant from a grocery store or a rooted cutting

Clean Up Kit materials:

- cotton balls
- artificial fur (or authentic)
- rubber bands
- polystyrene pieces
- sponge
- liquid detergent
- straw (plant)
- newspaper
- plastic garbage bag
- drinking straw
- aquarium net
- paper towels
- twigs
- feathers
- string
- leaves or algae

Experiment #3

Oil and Water - Put approximately two gallons of water in a tub. Place several tablespoons of oil in the tub and watch the effects. Try to remove the oil from the water's surface using the materials provided in the Clean Up Kit. (Do not use the detergent yet) Gently tilt the tub back and forth to create small waves. Do this with and without a boom. How do the waves change the effectiveness of the boom? Gently blow across the surface of the water to simulate wind. How does the wind effect the oil? Record each material's effectiveness and make descriptive observations. Which materials were adsorbent and which materials were absorbent? Note which materials worked the best to remove oil from the water. Add a few drops of the detergent. The oil sinks to the bottom of the dish. Would this have an effect on the organisms that live on the bottom? Try to clean off the oily clean-up materials with more detergent. Record your results on worksheet #3.

Methods:

Some methods to try and rate their effectiveness:

a) *boom of twigs or drinking straws tied together with string or rubber bands - pull across the spill, or place around spill to contain it

b) *string - wrap around spill on surface of water to contain spill

c) *drinking straw - blow bubbles in a ring around oil to contain spill, or in the middle of the spill to disperse it

d) *aquarium net - scoop up oil

e) sponge - place on oil and remove

f) artificial fur - place on oil and remove

g) cotton ball - place on oil and remove

h) polystyrene pieces - place on oil and remove

i) straw - place on oil and remove

***methods for Oil and Water experiment only**

j) paper towels - place on oil and remove

k) feathers - stir and scoop up oil

l) leaves - place on oil and remove

m) liquid detergent - add a few drops to spill to disperse and sink oil

Presentation:

Have students from each group describe what happened in each of their experiments. Initiate a discussion and/or evaluation with the following questions:

Experiment #1

- What did students expect would happen to their plant?
- Were they surprised?
- If the oil was successfully washed off, do they think the plant would recover?
- Can the soil be successfully washed off?

Experiment #2

- Do they think they washed all the oil out of the soil?
- Which methods worked the best? Why?
- How much rinsing did it take?
- Were there any new ideas for removing the oil? How successful were they?
- How can they be sure the soil is free of oil?
- Do they think the soil is safe to plant crops in? Why or why not?
- Do they think that oil is safe for the environment? Why or why not?

Experiment #3

- Did they remove all the oil from the water?
- Is the water safe to drink?
- Which methods/materials were most effective at removing the oil?

  (ANSWER: fake fur, feathers, paper towels)

- What does this suggest about the effect on wildlife exposed to an oil spill?

  (ANSWER: Fur and feathers actually attract oil which result in the death of sea animals and birds.)

- Were there any new methods or materials used? How successful were they?
- Which materials were absorbent and which were adsorbent?
- Would the same method work for every spill?
- How would weather conditions effect clean up operations?
- Would any methods have a harmful effect on the environment?
- How could an oil spill be prevented from spreading?
- Who should be responsible for cleaning up a spill?
- How might oil spills be prevented?

CLEAN UP AND DISPOSAL:

Dispose of all contaminated soil, water, clean-up materials, and newspapers in a safe non-toxic way. Remove all residual oil from the water using the most effective materials before pouring water down the drain. Put all contaminated materials in a plastic bag and tie securely before disposing of the bag.

Extension:

Take a field trip to the San Francisco Household Hazardous Waste Collection Facility or to the Wastewater Treatment Plant to learn more about proper handling and disposal of used motor oil. Invite a speaker from Clean Bay, the oil consortium that is responsible for responding to spills in San Francisco Bay, or from the Center for Marine Conservation. For example, invite someone from the Bureau of Environmental Regulation and Management to speak about Water Pollution Prevention.

Student Info Sheet

Oil is Toxic

Oil is a product processed from petroleum. Petroleum products in the form of crude oil, refined oil, gasoline, and natural gas are among the most commonly used energy sources in the world. When burned, they release energy in the form of heat. This energy is used to warm homes, drive the pistons in the engines of motor vehicles, and heat water for use in factories and power plants.

Petroleum is a natural resource that is derived from the remains of organisms (plants and animals) that lived millions of years ago. Time and compression have turned their remains into a thick black liquid. Oil wells pump petroleum from deep in the ground. Although there are vast amounts of petroleum in the world, petroleum takes millions of years to form, and is therefore considered a nonrenewable resource. When we use it all up, it will take millions of years to generate more. Recycling oil that has been used for lubrication in engines prolongs its availability for use. Most of this oil can be cleaned and used again, or it can be burned as fuel for large ships or factories.

There are many different grades of oil used for many different purposes. For example, refined oils are used for lubricating motor engines and crude oils for burning and producing heat. Most, however, are hazardous to living organisms. Plants in oily soil turn black and die. Animal fur and feathers coated with oil lose their insulating qualities and the animals can die of exposure. Humans who breathe too many petroleum fumes can develop diseases. Oil and gasoline are also highly flammable, creating fires that release toxic smoke. Crude oil is very sticky and cannot easily be removed. This is why oil spills are so hazardous to marine organisms. When oil is spilled into the ocean, it takes years for the oil residues to disappear and for new organisms to replace the ones that died.

There are several methods that have been developed for cleaning up oil spills. These include mechanical methods such as booms, skimmers, and bubble barriers; chemical methods including burning, coagulating, and sinking of the oil; and other methods of adsorption, absorption, and bioremediation. Booms and bubbles contain the oil after it is spilled. Skimmers are used after the oil is collected to remove the oil from the water surface. There are many different forms of skimmers, some use suction and others are made from rope that act like mops to remove oil. Chemical burning agents are used to help ignite oil and burn it off, herding agents coagulate or hold the oil together in one mass, and other chemical agents are used to make the oil sink below the surface of the water. Various materials or sorbents are used to adsorb or absorb the oil. Sorbents that hold oil on their surface but do not collect it internally are called adsorbents. Sorbents that hold oil on their surface and collect it internally are called absorbents. Finally, the bioremediation method involves introducing microbes or bacteria that decompose and oxidize the oil. Of all the methods mentioned, the mechanical booms and skimmers are used most frequently as they are the least disruptive to the natural environment. The effectiveness, however, of these methods is greatly affected by weather conditions. Wind and wavy water can make oil collection very difficult and hard to control.

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Oil is Toxic (pg. 2)

Oil is an excellent lubricant for machine parts. It prevents metal parts from sticking to one another, and removes particles of dirt. Every time we change the oil in our cars we are left with 3 to 5 quarts of dirty motor oil contaminated with heavy metals. Many people dump this used motor oil down sewer or storm drains (See fact #1). The oil mixes with water in the drain and goes through a water treatment plant. Unfortunately, heavy metals are not successfully removed in the filtration process and are released directly into the ocean polluting the water and killing living organisms. The oil is disruptive to the system, causing clogs and blockages, and kills beneficial microbes. Some people dump oil onto the ground (See fact #2). The oil may kill animals or plants in its path and can even slowly filter into drinking water systems. Dumping used motor oil is illegal because of these health and environmental risks (See fact #3). The correct way to dispose of used motor oil is to take it to a gas station or recycling center that collects it. Information on where to take used motor oil in San Francisco is available from the Hazardous Waste Hotline (415) 554-4333.

FACTS ABOUT OIL:

1) One quart of used motor oil poured down a storm drain or sink can pollute 250,000 gallons of water. (CA Department of Conservation, Division of Recycling)

2) In the USA, only 10% of the amount generated by people who change their own motor oil is returned to collection programs. (EPA, 1990)

3) Americans throw away enough used motor oil every year to fill 120 super tankers. (CA Department of Conservation, Division of Recycling)

4) In 1992, 42.7 million gallons of oil were spilled world wide. (1992 EPA, Oil Spill Intelligence Report)

Student Worksheet

Oil and Plants – Experiment #1

Name: _____

Take the small plant and pour 1/4 cup of motor oil into the soil around the roots. Water regularly. Using this data sheet, note any changes in the plant and the soil over the assigned period of time. Before recording your observations, indicate how many days have passed since the start of the experiment.

Date: _____

DAY # 1 _____

_____

_____

DAY #___ _____

_____

_____

DAY #___ _____

_____

_____

DAY #___ _____

_____

_____

DAY #___ _____

_____

_____

Write a brief analysis of the effects of oil on this plant.

_____

_____

Do you believe that oil is safe for the environment? Why or why not?

_____

_____

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Student Worksheet

Oil and Soil – Experiment #2

Name: _____

Put one cup of soil into a dish or aluminum pie plate. Pour 1/2 cup of motor oil over the soil in the dish. Add 1/2 cup water. Mix well. What does the water look like? Pour off the water. Using the detergent and/or any of the other tools found in the Clean Up Kit, try to remove the oil from the soil. Record your observations on this data sheet.

Methods/Materials	Approximate Amount	Effectiveness
# 1		
# 2		
# 3		
# 4		
# 5		
# 6		
# 7		
# 8		
# 9		
#10		

Write a brief analysis of the effects of oil on soil.

_____

_____

_____

_____

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Student Worksheet

Oil and Soil – Experiment #3

Name: _____

Put 1-2 gallons of water in the tub. Place 2 tablespoons of oil in the tub and watch the effects. Try to remove the oil from the water's surface using the materials provided in the Clean Up Kit (DON'T USE THE DETERGENT YET). Note which materials work the best to remove oil from the water. Of the successful materials, try to determine which ones are absorbent and which are adsorbent. Add a few drops of the detergent. Try to clean off the oily clean-up materials with more detergent. Record your results on this data sheet.

Materials/Methods	Approximate Amount	Effectiveness	Absorbent or Adsorbent?

Write a brief report on an oil spill that you are aware of and difficulties of clean up.

_____

_____

_____

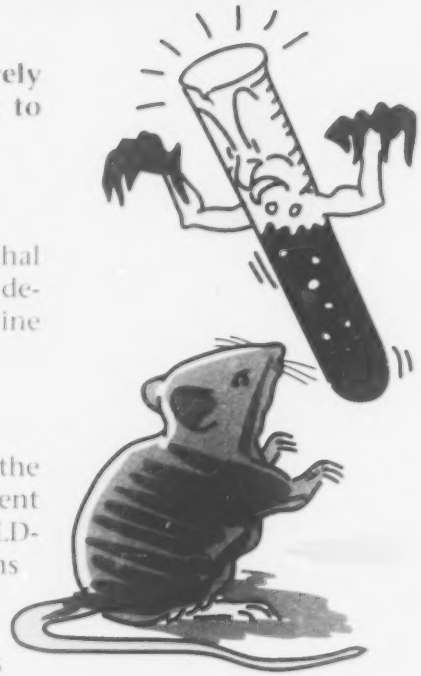
_____

The Lethal Dose

Use with other toxics lessons.

Lesson Summary:

Students test their ability to taste salt (NaCl) in successively diluted concentrations. They complete a worksheet to understand the concepts of dilution and toxicity.



Key Concept:

Depending on its dose, everything can be toxic. The lethal dose is the dose of a toxic substance that causes death. By determining the lethal dose of a substance, scientists determine the toxicity of that substance.

Background:

The lethal dose of a substance is often determined by the LD-50 test. This is when 50% of the subjects in an experiment die due to exposure to a specified dose of that substance. LD-50s are determined in very controlled laboratory conditions where generally only one substance is tested at a time. Also, LD-50s generally test for acute effects (single dosages). Less research has been done on the combined or synergistic effects of these symptoms or on chronic, long-term exposure.

As scientists cannot conduct these types of experiments on people, animal experimentation is used to define the lethal dose of various substances. Rats are the main animals used in these types of experiments. The LD-50 is determined for rats first, and then the LD-50 for human beings is determined by extrapolation.

In this lab, students will make and sample successively diluted salt solutions. If 10 students that weighed 100 lb. (50 kg.) each drank 25 cups of the first solution at one sitting, about 50%, or about 5 students, would die from salt poisoning. The same 10 students would have to drink several billion cups of the last solution at one sitting to cause a fatality of 50% from salt poisoning. These figures would be very different, however, if the students were sampling a more toxic substance such as nicotine or DDT.

Vocabulary:

- LD-50
- toxicity

Materials:

- "LD-50 for Other Substances" worksheet
- worksheets for salt experiment
- 1 container of table salt (NaCl)
- distilled water
- 20 8 oz. clear plastic cups for salt solutions (reuse after experiment)

Continued on next page.

Materials Cont...

- 30, or one for each student, additional cups for spoon rinsing (reuse after experiment)
- plastic spoons for each student (reuse after experiment)
- permanent marker
- metric scale
- 50 ml. beaker
- stirrers: wooden sticks or plastic straws

Procedure:

1. Put numbers on cups from 1 to 20 with a permanent marker. Keep the cups in order during the entire experiment.
2. Fill Cups #2 to #20 with 50 ml of distilled water (about 1/2 full).
3. Measure 25 g of NaCl. Pour salt into Cup #1 and add 100 ml of distilled water. Stir until dissolved.
4. Pour 50 ml of Cup #1 contents into Cup #2. Using a new stirrer, mix contents of Cup #2.
5. Pour 50 ml of Cup #2 contents into Cup #3, stir with a clean stirrer.
6. Repeat until all cups, #1 to #20, have a salt solution.
7. Complete columns one and two on the data sheet.
8. Starting with the lowest salt concentration (Cup #20), have students use their own spoons to take a taste of each cup by pouring a small amount of each solution into their spoons. Make sure each student rinses their spoon after each taste in their own cup of plain distilled water. At what concentration do they start to taste salt?

Extension:

Use a conductivity meter to indicate salt presence even in solutions of such low concentration that no salt can be tasted. Also, test tap water and other liquids for low levels of NaCl.

Student Worksheet

LD–50 for Other Substances

Name: _____

Animal experimentations are used to determine the lethal dose of various substances. Rats are the main animals used for three types of experiments. According to one standard, the lethal dose of a substance is determined when 50% of the animals in an experiment die due to exposure to a specific dose of that substance. This information is known as the LD-50 for that substance.

As scientists cannot experiment on people, most LD-50 data for humans is extrapolated from animal data.

Below is the LD-50 for several substances. Convert the LD-50 data from rats to the LD-50 data of a 75kg person.

Example: LD-50 for rats = 29700 mg/kg
LD-50 for humans = 75 x 29700 mg/kg
= 2227500 mg/kg or 2228 g/kg

Based on ingestion of the following substances.

Substance Name	LD-50 data for a for substance (from rats)	LD-50 for a 75 kg person (165 pounds)
Sugar	28700 mg/kg	
Alcohol	14000	
Vinegar	3310	
Salt	3000	
Malathion	1375	
Aspirin	1000	
Ammonia	350	
DDT	113	
Arsenic	48	
Nicotine	1	
Dioxin	.001	
Botulinumtoxin	.00001	

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Student Worksheet

Salt Experiment

Name: _____

Cup Number	Volume of water	Amount of NaCl	Do you taste salt
1	100 ml	25 g	yes or no
2	100 ml	12.5 g	

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Section 4 Solutions

14 Changing Habits

Precede with What Is Garbage?, follow up with Garbage Free Lunch

Lesson Summary:

Students list ways to reduce wastefulness and conserve energy. They then choose what wasteful habits they can change in their own lives and make a commitment to these changes.

Key Concept:

Reducing waste is a personal decision. In order to have an effect on the waste problems in our society, each individual must decide the best way he or she can change personal behavior and reduce wastefulness.

Background:

Many of us are wasteful without even realizing it. We have become wasteful by habit. The average American produces 4.3 pounds or more of garbage per day, a higher average than any other country in the world. We also use up more natural resources than any other country. We cause damage to habitats when we remove resources and waste them when we throw garbage away into landfills. Landfill space is limited and it is difficult to site new landfills. As the world population continues to grow, there will be greater demands placed on our limited supply of resources and land. We can no longer afford to be wasteful. We must develop new habits that help preserve natural resources and keep the environment healthy.

Recycling of metal cans, glass, plastic bottles, paper, food scraps and yard trimmings is a beneficial habit to develop. However, recycling alone cannot save all of our natural resources. The following combination of methods can most significantly reduce waste and conserve resources: reducing our use of energy and our consumption of products made from natural resources, reusing items, composting yard and food waste, and then recycling what is left.

Procedure:

1. Discuss with students how we waste energy and resources without even thinking about it. Without conscious thought, wastefulness becomes a habit. Discuss examples of unnecessary wastefulness that people practice all the

Vocabulary:

- consumption
- habits
- natural resources
- recycle
- reduce
- reuse
- waste

Materials:

- Changing Habits Student Worksheet

time. For example, leaving the water running while brushing your teeth, throwing out recyclable items, leaving lights on when it is not necessary, buying individually wrapped items rather than items packaged in bulk or not packaged at all, or buying more food than you can eat.

2. Have students come up with ideas to cut down on wasteful consumption of resources. Have one student record these ideas on the board.

3. Distribute the "Changing Habits Checklist" to students or have students write their own. As a group, add new ideas to the list. Tell students that the list is an opportunity for them to decide what habits they can change easily, and to make a commitment to these changes now.

4. Have students fill out the checklist and keep it in their desks for reference. Ask students why some habits are easy to change while others are not. What habits did they choose to change? What do they know they will not do? Why? Have students find a partner or friend for support to help them keep their commitment to developing non-wasteful habits.

5. Refer to the checklist in the future to see if habits have changed. Why or why not? What would make it easier for them to follow through with their commitment?

6. Have students bring their checklists home and share them with their families.

Extension:

After taking steps to reduce waste at home, have students keep track of savings that have occurred as a result of changed habits. For instance, recycling at home may mean the family produces less garbage and can reduce their garbage service from two cans to one, saving $51.60 a year (for San Francisco residents using 32 gallon cans in 1993) and landfill space. Students living in apartment buildings may not see their garbage rates drop but they may not see them go up as fast as they otherwise would and they would also be saving landfill space. Keeping the thermostat lower or not heating the house when no one is home

should result in a reduced P. G. & E. bill. Walking more or using public transportation saves petroleum and should reduce the monthly gasoline bill as well as cutting down on car services and repairs. Buying items in bulk uses less packaging and saves trees and other resources. Using both sides of paper and saving paper bags also saves trees. Students can tally up the energy, resource, and financial savings for their families as a result of changed habits.

For more information about recycling in San Francisco, call the Recycling Hotline at 554-6193.

Student Worksheet

Changing Habits – Checklist

Name: _____

	I will always	I will sometimes	I will never
1. Give my clothes that don't fit anymore to someone who can use them.			
2. Use both sides of a piece of paper.			
3. Use entire sheet of paper.			
4. Write smaller.			
5. Reuse paper bags.			
6. Use only 1 paper towel after washing hands in public restrooms.			
7. Use a cloth napkin at meals.			
8. Use a reusable cup instead of disposable paper, plastic or polystyrene cup.			
9. Save envelopes and wrapping paper to reuse.			
10. Buy recycled paper products.			
11. Recycle glass, aluminum, and steel cans at home.			
12. Compost yard and food scraps.			
13. Eat leftovers instead of throwing them away.			
14. Use scraps of paper for art projects.			
15. Fix broken objects instead of throwing them away.			
16. Trade books, toys, and games with friends.			
20. Talk to people about conserving resources.			
21. Help other people change their habits.			

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The Twenty-Foot Swath

Precede with Home Survey or What Is Garbage? , follow up with Not In My Back Yard!

Lesson Summary:

Students read and discuss the essay "My Twenty-Foot Swath." They identify various issues of global concern and identify ones that concern them most. Each student then writes an essay about their concerns, including what they will do to contribute to solving the problem.

Key Concept:

One person alone cannot end world problems. However, many people, each working in his or her own way, can together make a significant difference in global problems.

Background:

Today's global concerns are threatening all life on earth; world hunger, natural resources depletion and toxic poisoning, to name a few. It is hard to imagine what one person can do to have an effect on such huge and complicated issues. But we are not alone! When combined, individual efforts to end global problems can and do make a difference. Examples of this are everywhere. The AIDS movement has raised public understanding and support to find a cure for AIDS. Environmental organizations work with thousands of volunteers to help bring about changes in the treatment of critical environmental issues.

An increasing number of businesses and agencies have shown their concern and responsibility to various environmental, social, and economic issues. In San Francisco, City government offices recycle tons of used paper each year. Many businesses now donate a percentage of their income to charity, and use environmentally sound products, such as recycled paper. Universities, government, and businesses hold conferences that address the role everyone can play in resolving local and global issues.

Procedure:

1. Hand out the essay, "My Twenty-Foot Swath" to each student to read in class, or as a homework reading assignment.

Vocabulary:

Select appropriate words from essay text.

Materials:

- Essay "My Twenty-Foot Swath" for each student

2. Discuss the essay with your class. Be sure everyone understands the vocabulary words. Ask some of the following discussion questions:

   A. Do you agree with the author? Is his keeping a 'low profile' a good idea or do you think he should have spoken up more or asked others to become involved? Was writing his essay a good idea? What did this accomplish?

   B. Discuss the fact that the changes did not happen quickly, and some changes did not happen at all. The author does not seem to believe that other people will stop littering, and is not trying to convince people to stop. He did, however, succeed in keeping his twenty-foot swath clean, and received support in the form of the trash cans that were mysteriously delivered and maintained. He knows he is not alone in his vision. Why does he feel good?

   C. What can you tell about this person from his writing? Either on the board or on a piece of paper, have students come up with words that describe the author. Is he angry, hopeful, cynical? What do you think he does for a living? What else can you tell about this person?

3. On the chalkboard, have students make a list of problems that are important to them. Try to come up with a wide range of concerns, from things that affect them directly, such as litter or crime on their street, to larger problems such as world hunger.

4. Have students select a topic from the board or come up with one of their own and write a two-page essay that incorporates the things they have learned from "My Twenty-Foot Swath." They must first express their feelings about the issue, ways they think the problem could be resolved, and then what each student personally could do to contribute to solving the problem. They may include ideas that would require assistance from others.

Extension:

From the essay, develop a list of "Things Students Can Do To End World Problems." Share it with the rest of the school. Select one or two issues of concern and have students become actively involved with them, either as volunteers, or in some other way that shows they really can make a difference.

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Student Info Sheet

My Twenty-Foot Swath

Kenneth Lundberg
Covenant Companion
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"I worried so much about world hunger today, that I went home and ate five cookies." Did personal or global problems ever become so overwhelming that you were immobilized, or driven to some action that actually aggravated the problem? Have you experienced such frustration at the hopelessness of solving the problems of poverty, environmental pollution, or human suffering that you could avoid it only by deciding that you were powerless to do anything about their alleviation? This is called Responsibility Assumption Overload (RAO). Here's how I deal with this feeling.

I park my car away from my building at work. That way I get both exercise and a parking space, as everyone else competes for spots next to the entrance. My morning and late afternoon strolls take me on a stretch of lawn between the tennis courts and the soccer field, and across an occasionally used softball diamond. The lawn is twenty feet wide, more or less. Soft and green, it was originally very littered. Tennis players discard tennis ball containers (and their flip-tops), worn out sweat socks, broken shoelaces, and energy candy bar wrappers. Soccer game spectators leave behind beer bottles and junk food cellophane.

In my early days it disgusted me, and my thoughts centered on ways of correcting the situation: writing letters to the campus newspaper (no doubt totally ignored); campaigning for anti-litter regulations (who would enforce them?); organizing a "Zap-Day" cleanup (leaving 364 days for littering). All my noble efforts would have demonstrated indignation, but they would not have changed the appearance and/or condition of the area.

So, I decided to take ownership. I would be the solution. I did not tell anyone of this; it was probably against some rule or another. I decided that I would be responsible for the environmental quality of this twenty foot swath. I did not care what other parts of the campus were like. They were someone else's problems. But each day, going from and to my car, I picked up litter.

At first it was as much as I could conveniently carry. Then I made a game of it, limiting my picking to ten items each day. It was an exciting day when I realized I was picking faster than 'they' were littering. Finally, the great day arrived when I looked back on my twenty feet of lawn - now perfectly clean.

Where did I put the litter? At first, I brought it into a wastebasket in the building or took it to the car to bring home. Then a curious thing happened. One day, large orange barrels appeared at each end of my swath. Someone in maintenance had become my silent conspirator - periodically emptying and replacing the barrels. He, too, knew the wisdom of keeping a low profile about it all.

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I've done this for several years now. Has general campus appearance changed? Not much! Have litterers stopped littering? No! Then if nothing has changed, why bother?

Here lies the secret. Something has changed. My twenty foot swath - and me! That five minute walk is a high spot of the day. Instead of fussing and stewing and storing up negative thoughts, I begin and end my workday in a positive mood. My perspective is brighter. I can enjoy my immediate surroundings - and myself - as I pass through a very special time space.

"It" is better because of me. I am better because of "it." "We" enjoy the relationship. Maybe, even, "it" looks forward with anticipation to my coming.

With a brighter outlook, I have learned a lot of things that would have gone unnoticed. For instance, I have learned that tennis players grunt a lot. There seems to be some correlation between the quality of the grunt, especially on the serve, and the quality of one's game. Maybe I have discovered the secret of the game. I have also learned that soccer players curse a lot, but there does not seem to be any correlation between that ability and soccer skills. I have even learned that most soccer spectators, at least at my college, come to eat, drink, and talk - not to watch the game.

My learning - and the twenty foot swath - does not stop at the building door. There is an important principle that follows wherever I go. I cannot solve man's inhumanity to man, but I can affirm, with a smile and a word of appreciation, those who feel burdened by the need to work at lowly jobs.

I cannot right the imbalances of centuries of discrimination, but I can "lift up" someone who feels the weight of a poor self-image. I can treat women as equals without solving the problems of sex discrimination. I can seek out the social and economic litter in my own "twenty foot swath" without demanding of myself that I "clean up the whole world."

I now practice a discipline of leaving each time-space capsule of my life a little better than when I entered it. Each personal contact, each event, each room I enter becomes a small challenge. I want to leave it improved; and thereby, maybe - just maybe - my having been there will make life better for someone else.

I am becoming more and more disenchanted and suspicious of revolutionaries, crusaders, militants, and do-gooders. Many, if not most, seem to be more concerned about being right than being loving or effectual. The zealot, no matter how well intentioned, often leaves a trail of wounded people while in the pursuit of the cause.

Is this all too myopic - shutting one's eyes to the greater concerns? It does not need to be! I now have a twenty foot swath. Next year it may be forty or sixty or eighty feet wide. Ten talents were not required of him who had been given only one. Too many people stumble by taking on causes too great for their level of discernment and discipline. They need to begin to catch the vision of the important promise, that the meek shall inherit the earth, not the indignant or frustrated.

Lundberg, Kenneth V. "My Twenty Foot Swath," Covenant Companion, October 1982.

16

Garbage Free Lunch

Precede with What Is Garbage? , follow up with Compost In The Classroom.

Lesson Summary:

Over a five-day period, students survey the items in their lunch and the packaging used for these items. The students find ways to reduce the amount of garbage they make and replace disposable items with ones that can be reused, recycled, or composted.

Key Concept:

Waste comes from over-packaging, uneaten food, not reusing durable products such as bags and containers, using disposable items instead of durable items, and from throwing away recyclable goods. A little thought and effort can prevent a lot of waste.

Background:

The garbage that we throw "away" actually goes to a sanitary landfill. We throw "away" a lot of garbage, and we have limited landfill space. In order to extend the life of the landfill San Francisco depends on, we have to throw away less garbage. A look at our own lunches shows that everyone contributes to the garbage problem.

In the past, people produced much less garbage. Thermoses carried drinks, bottles and cans were recycled, lunch boxes were reused, and food waste was composted. We can still use these waste reduction techniques today. The goal of this lesson is to convert a 'garbage-y' lunch into a 'garbage free' lunch. Garbage free lunches are becoming more popular in San Francisco and across the country as more students take responsibility and change their own wasteful habits.

Procedure:

1. Prepare your own garbage-free lunch as an example, using "How To Make a Garbage Free Lunch", or call the San Francisco Recycling Education Program at 554-3400 for a class presentation.

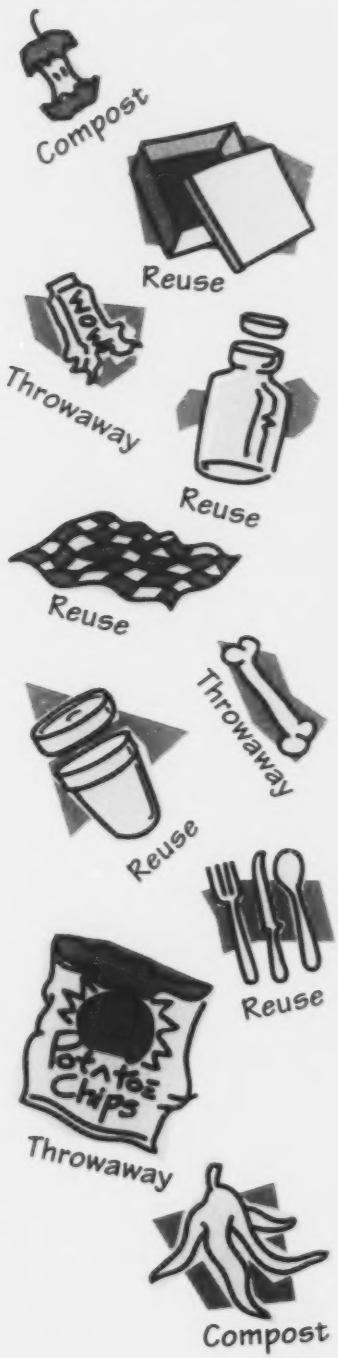
2. Prepare students by telling them they must bring their lunch waste to class, including all leftover food, plastic bags, paper bags, dishes, beverage containers and napkins.

Vocabulary:

- compost
- landfill
- packaging
- recycle
- reduce
- replace
- reuse

Materials:

- "Daily Lunch Items" Worksheet
- "How To Make A Garbage Free Lunch" Info Sheet
- Sample graph



3. Hand out the "Daily Lunch Items" Worksheet. For Day 1, under the Items From My Lunch column, have them list every item that they would have thrown away, including uneaten food, napkins, plastic bags, beverage containers, plastic plates or boxes, apple cores, orange peels, etc. In order to have an effective experiment, every single item must be listed!

4. For each item listed, enter the appropriate check or response in the following six columns. For example, a plastic container could be reused, or perhaps is already being reused. A candy wrapper or a plastic potato chip bag is garbage and must go "away" to the landfill. Next time it could be replaced with something reusable, or recyclable like an aluminum can or glass bottle. Buy candies and chips in bulk containers that are either reusable or recyclable.

5. Discuss with the students how they can create a garbage-free lunch. From your example show them how you have replaced disposable items with reusable and recyclable ones. Distribute the handout, "How To Make A Garbage Free Lunch", or post it on a bulletin board. Discuss other ways to reduce waste.

7. Discuss composting with your students. All food waste can be composted, except meats, cheese, and very oily items, like a mayonnaise-slathered piece of bread. Your class may want to try starting a bucket of compost in the classroom to compost food waste such as fruits, vegetables, and grains. (See "Compost In The Classroom" lesson.) Untouched uneaten food may be saved for later or brought home to a sister or brother.

8. Continue the experiment for 4 more days. Students should replace disposable items with reusables, and reuse these items each day, indicating this on their tally sheets. Students should be able to have a completely "garbage free" lunch on some days.

9. At the end of five days, have students tally up the totals in each column for each day. Have them draw a graph that

shows these totals (See sample graph pg. 116). The number of items thrown "away" should decrease and the number of items reused or recycled will increase over the five days. The student will see that he or she has made a big difference in the amount of garbage he or she produces.

10. Repeat this activity periodically throughout the school year.

Extension:

Make a large poster illustrating the results of this activity. Have it displayed in a prominent place in the school, encouraging other classes to reduce their lunch time garbage. Or make a school-wide policy rewarding students who have garbage free lunches. Be sure the reward does not produce more garbage! A cloth lunch bag or extra recess time would be a suitable reward.

Student Info Sheet

How To Make a "Garbage Free" Lunch

DISPOSABLE ITEMS		REPLACE WITH
• paper bag	→	• reusable cloth bag or lunch box
• paper napkin	→	• cloth napkin
• disposable drink container	→	• thermos, recyclable glass or aluminum, reusable plastic
• plastic bag	→	• reusable container or recyclable foil
• disposable box or plate	→	• reusable container or recyclable foil
• individual packages	→	• buy in bulk - less packaging and cheaper - use a reusable container for individual servings

* Save uneaten food for later or bring home to a brother or sister.

* Compost food waste such as apple cores, banana peels, carrots, bread crust, and crackers.

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Student Worksheet

Daily Lunch Items

Name: _____

Directions:
1. Write down the type of packaging materials and food waste left over after eating your lunch. (Is it a PAPER bag, PLASTIC bag, ALUMINUM can, GLASS bottle, or FOOD leftovers?)
2. Put an X mark in the columns that best describe what you will do with the materials.

Item #	Lunch Items	Reuse	Recycle	Compost	Landfill	Next time replace with
1	brown paper bag	X				Cloth Bag

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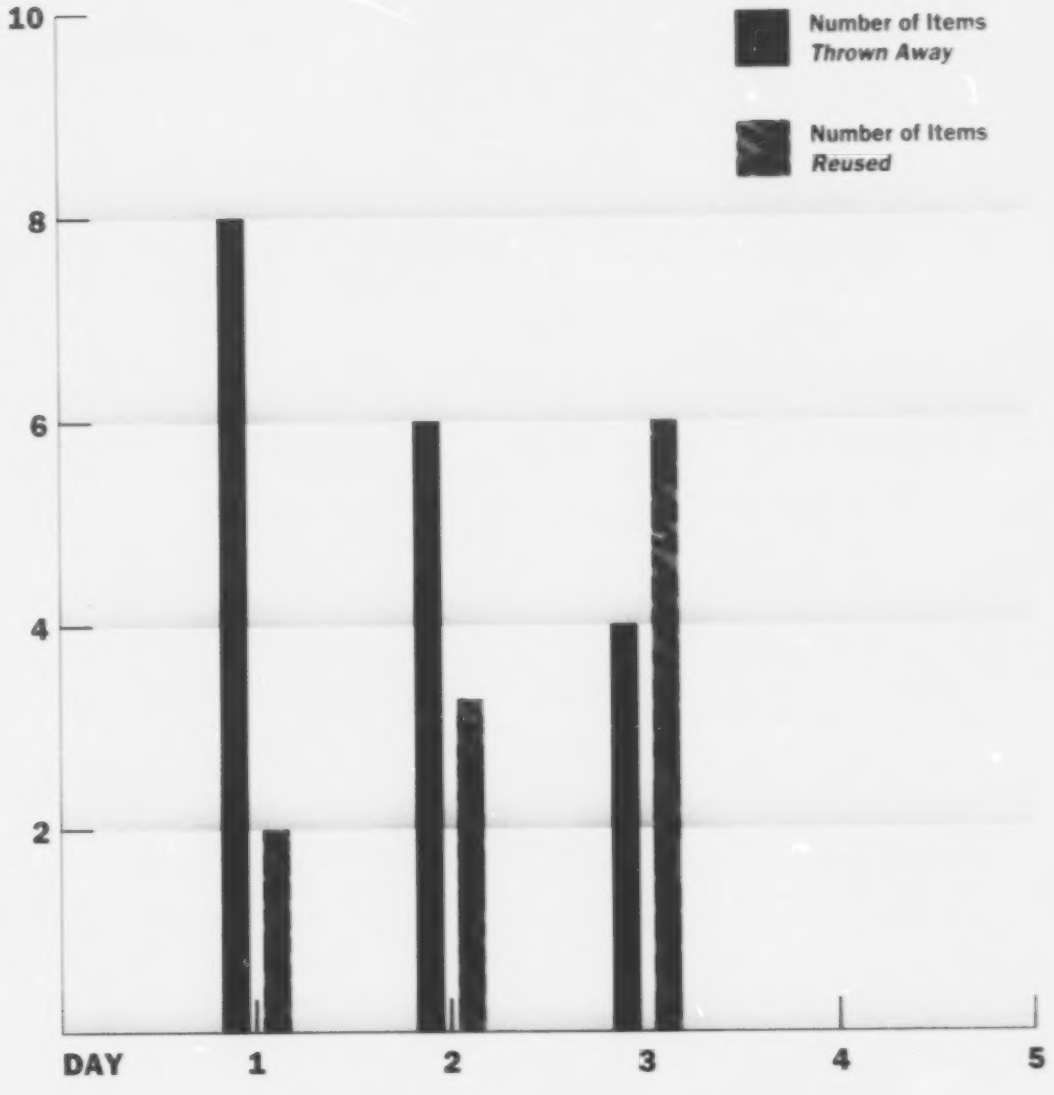
Class Totals - Sample Graph



17 A Litter Walk

Lesson Summary:

Class takes a walk on school grounds or in neighborhood to pick up litter. Different types of litter are identified and separated. Recyclable items are saved for recycling.

Key Concept:

Picking up litter is a direct way to solve the litter problem.

Background:

Litter is unsightly and can be dangerous to people and animals. It is so common we often ignore its presence merely by "looking the other way". However, pretending litter does not exist only perpetuates the problem. The litter problem affects us all, and can only be solved by everyone contributing their efforts towards creating a cleaner environment. Some litter such as paper bags and paper packaging is recyclable, and some can be redeemed for money in California such as, glass bottles, aluminum cans, plastic soft drink bottles, and newspaper. It is expensive for the City's Public Works Department to continuously clean-up after littering.

Procedure:

1. Before the walk, talk to the class about the litter problem. Look up litter in the dictionary and discuss its several definitions. The definition we are concerned with is: carelessly discarded human waste materials or scraps. Ask your students if they recognize litter when they see it. Do they themselves litter? Why do people litter? Why is littering illegal?

2. Pass out the handout, "Enduring Litter". Discuss the length of time it takes for common items along the roadside to biodegrade or break down in the environment. What would happen if everyone littered and no one picked it up? Would it be a safe and beautiful world? Discuss why it is important to avoid littering and to pick up litter.

3. Choose students to carry the labeled plastic garbage bags. If you want students to use cloth gloves when picking up litter, pick 10 students to wear a glove on one hand. The rest of the class can be "litter scouts".

Vocabulary:

- biodegradable
- CA redemption value
- decompose
- garbage
- litter
- recyclable

Materials:

- "Enduring Litter" Info Sheet
- 5 reusable garbage bags, boxes, or buckets - label as follows:
  - glass
  - plastic bottles
  - aluminum cans
  - paper
  - other
- 5 pairs of cloth, reusable gloves (optional)

4. Take the class on a walk through the neighborhood surrounding the school. Each piece of litter that is seen must be identified and placed in the correct recycling container (bag, box, or bucket). Distinguish, if necessary, between items that are litter (polystyrene, paper, and plastic) from things that look like litter (old leaves or broken branches). Look for all recyclables and the "CA Redemption Value" stamp on cans and bottles. These can be redeemed at a nearby recycling center or large supermarkets.

5. At the end of the walk, spread the contents of the container labeled "other" onto a flattened garbage bag or tarp. Use these garbage items to discuss what alternatives could be chosen in the future to avoid producing this non-recyclable garbage. (buying products in recyclable packaging, buying products with less packaging, buying items in bulk, etc.). Throw these materials into the school trash dumpster or garbage can. Take all the material that can be recycled including the paper, glass bottles, aluminum cans, and plastic soft drink bottles to your school's recycling bins, the nearest recycling center, or a major supermarket. Save the garbage bags and gloves for reuse.

6. After the litter walk, stop and look at what you and your class have accomplished. Does it look better? Ask your students if they feel differently about litter now than before the walk. Do they feel differently about their neighborhood after cleaning it up? How? Will they pick up litter when they see it in the future? Why or why not?

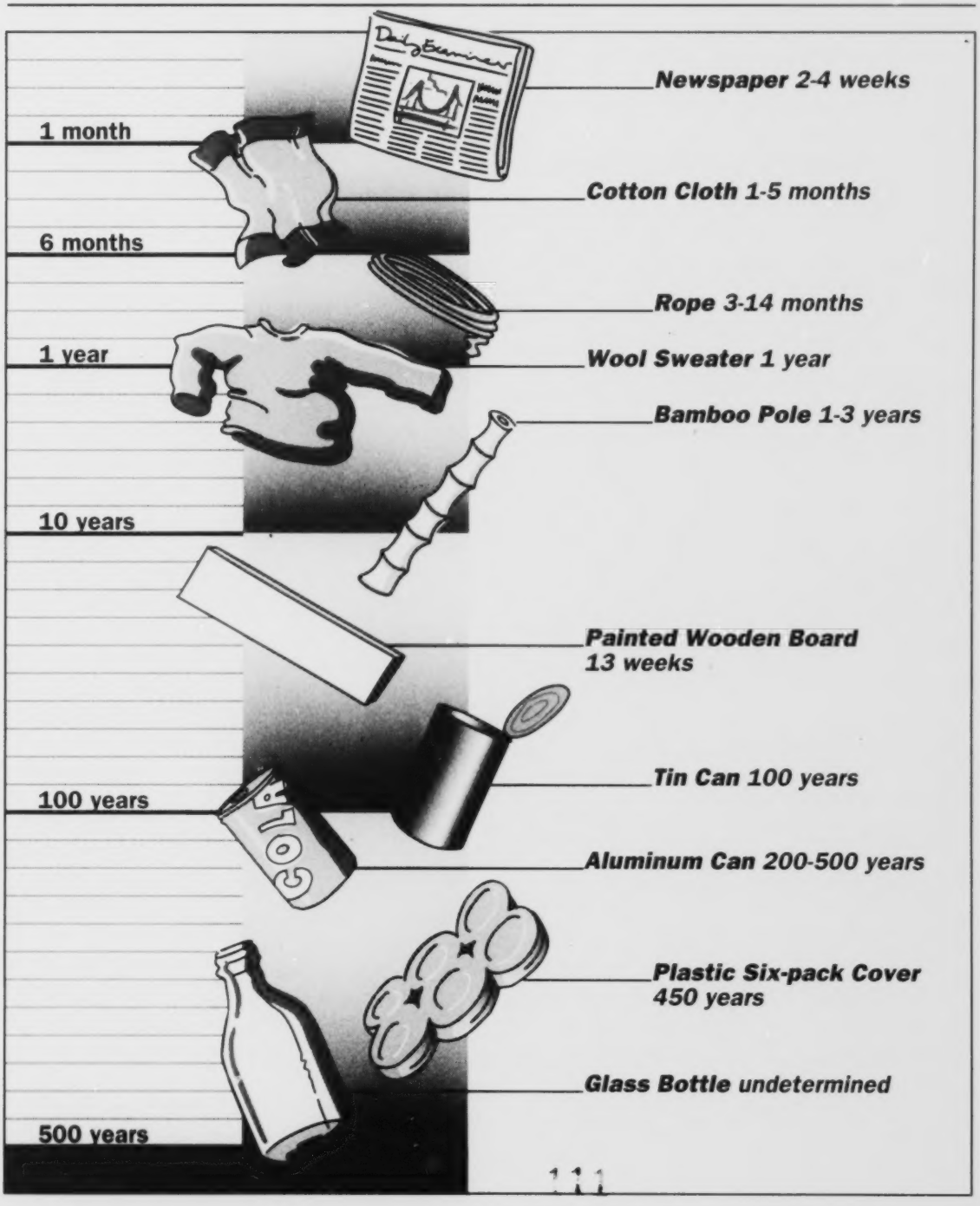
7. Discuss where the litter comes from. Is all of it dropped on the ground by people, or does some of it blow out of garbage cans, litter receptacles, trucks, or other sources?

Extension:

Have your class or club pick up litter on the school grounds or in the neighborhood on a regular basis. Save recyclables collected and redeem them for money at a local recycling center. Use the money earned to plant trees or to landscape. See the difference it makes in the quality of the area. Make a request to your principal that more garbage or recycling cans be placed on the school grounds. Write your legislator for information on anti-litter laws.

Student Info Sheet

Enduring Litter



Packaging Your Product

Precede with Changing Habits, follow up with Junk/Art.

Lesson Summary:

Students examine product packaging and identify the various purposes served by the packaging. Students then design alternative packages that are less wasteful of resources and minimize the waste which must be disposed.

Key Concept:

Packaging uses natural resources and contributes vast amounts of garbage to our landfills. Excess packaging can be avoided or redesigned to effectively meet packaging requirements without unnecessarily wasting natural resources. Packaging should contain recycled content to create a market for our recyclables, produce the least amount of waste, and be recyclable.

Background:

Manufacturers consider a number of factors when designing packages for their products. They prefer packages that most economically meet a number of requirements. These requirements include preservation of product quality and compliance with government regulations. For example, U.S. Food and Drug Administration laws require that the packaging for many products be designed to prevent spoiling and harmful tampering. Manufacturers also want packages that can be efficiently transported and stored, appeal to the consumer, and advertise their product.

Discarded packaging is the largest single component of household waste. It makes up approximately one-third of the nation's wastestream (29.2%, EPA, 1990). Packaging constitutes 34% of the paper, 85% of the glass, 40% of the aluminum, and 49% of the plastic used in the United States!(EPA, 1990) And that doesn't count the amounts of petroleum, water, and electricity used in the manufacturing of packaging.

Consumers play an important role in determining the types of materials used in packaging. We can influence product packaging by buying products that are packaged properly but not excessively, in materials that either are recyclable, and made from recycled materials. If consumers stop buying products that are over packaged and wasteful, manufacturers will have to

Vocabulary:

- consumer
- disposable
- manufacturer
- natural resource
- prototype
- recyclability
- reusable

Materials:

- "Packaging Pros & Cons" Info Sheet
- "Packaging Materials" Worksheet
- Environmental Shopping Guide (in Resource Section)
- collection of packaged products such as: pump toothpaste, lipstick, TV or microwave dinner, toy (in plastic), pen (five-pack), soda pop (six-pack), laundry soap, toilet paper

Continued on next page.

Materials Cont...

- materials to design and construct prototype packages: felt markers, cardboard, glue or paste, newspaper, tape, staplers, construction paper

respond by modifying their products' packages to reflect these concerns and demands.

Procedure:

DAY ONE:

1. Distribute the worksheet, "Packaging Pros & Cons." Show various examples of packaging, using the samples you brought. Using the worksheet as a guide, discuss the functions, benefits and drawbacks of the packaging. Choose one of the products and discuss the following:

   (a) What are the most important packaging needs for this product (sanitation, breakage, etc.)?

   (b) Is the package designed for easy transport? Can many of them fit easily into a box or unit container?

   (c) Is the package safe for workers who are handling the product?

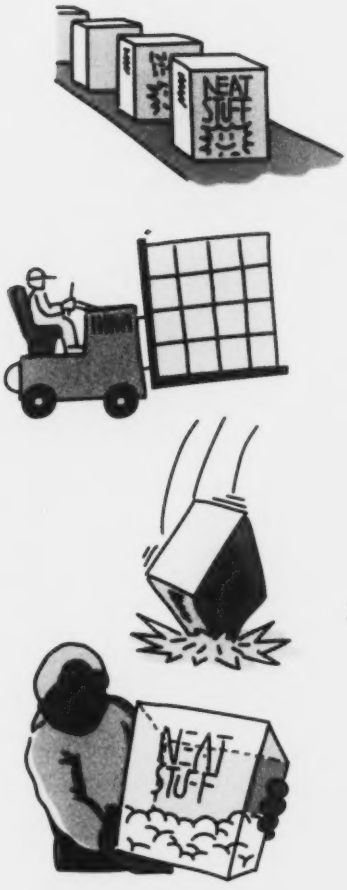
   (d) Is the package designed for function, consumer safety, to advertise the product, or for all three purposes?

   (e) Is all or part of the package necessary? Why or why not? For instance, a bottle is an example of a package that is necessary for storing liquid. A plastic wrapper on top of the bottle may not be necessary. How could it be designed to use less materials?

   (f) Are the package materials recycled or recyclable?

   (g) Is the package reusable? Could it have been designed for reuse?

2. Assign students to look at how different products in their own home are packaged and to bring 2 or 3 representative samples to class the next day. You may want to have them bring in one example of over packaging, and one example of appropriate packaging. Tell students that they will be designing their own environmentally sound package for a product.



DAY TWO:

3. Distribute the worksheet, "Packaging Materials". As a group, examine the products your students brought to class. Could these items have used less packaging? Discuss alternative packaging methods for these items. Could they have made the package from a recyclable or degradable material? Could they have chosen a material made from a renewable resource (trees), or a recyclable one, in place of a non-renewable resource (petroleum)? Did anyone bring in identical items that were packaged differently? Do they contain the same amount of the product!

   Using the Packaging Materials worksheet, compare the different ways that identical products are packaged, such as:

   (a) rope tied around firewood, firewood sold in plastic net bags, and compressed logs wrapped in paper;

   (b) newspaper vs. polystyrene peanuts stuffed in a shipping box;

   (c) glass milk bottles, paper milk cartons, and plastic milk jugs;

   (d) meats wrapped in butcher paper or on a tray with plastic wrap; and

   (e) toys packaged individually and toys sold from a large container.

   Fill out the worksheet using three items that were brought to class.

4. Have students choose one product from the collection that was brought in and, on a separate piece of paper, write packaging specifications for the product that are less wasteful of natural resources than the original package. Have them develop additional design specifications for the package, such as whether the packaging material should be reusable or recyclable. Have them describe what their package will be made of and what will be written on the outside of it. The package design should include information explaining how the consumer can reuse and/or recycle the package.

5. Allow time for students to create these new packages for their products using the materials you provide. Encourage creativity. Students can produce a 3-dimensional model, a drawing, or a package label to illustrate their idea for improved packaging.

6. Have students present their prototype package to the class. Have them explain the reasoning behind their designs.

Extension:

- Write a letter to the manufacturer of a poorly packaged product explaining that your class does not support the practice of over packaging and offer suggestions on how the packaging can be changed. Write a second letter to the manufacturer of one of the products identified as having a better package congratulating them on their design and explaining why your class preferred their package over the competitor. Encourage your students to share their innovative prototype packages with the manufacturer of their product. (Protect your students' rights, copyright the prototype!)

- Take a field trip to the supermarket and discuss packaging of different products.

Student Info Sheet

Packaging: Pros & Cons

The Value of Packaging

PROS

1. Holds the product
2. Protects contents from damage
3. Is sanitary
4. Is safe for consumer
5. Identifies contents
6. Prevents or reduces theft
7. Provides instructions for proper use
8. Complies with Food and Drug Administration laws
9. Advertises product
10. Is convenient for consumer and retailer
11. Makes product transportable
12. Decreases waste from spoilage and handling
13. Decreases waste from storage

The Drawbacks of Packaging

CONS

1. Disposable packaging fills up landfills
2. Production of packaging consumes energy (gas, oil, water, electricity)
3. Production of packaging can produce toxic wastes
4. Production of packaging consumes and wastes natural resources
5. Can mislead consumers regarding quantity and quality of a product
6. Increases the cost of the product to the consumer

Student Worksheet

Packaging Materials

Excessive packaging wastes natural resources and causes unnecessary trash to go to the landfill. Non-recyclable packaging increases garbage disposal needs. Packaging made of recycled materials helps "close the loop", which means that it ensures that materials are fully recycled.

Less Wasteful

Use of as little packaging possible to preserve product

Large quantity of product per package

Packaging made from renewable resources (paper)

Packaging containing recycled content

Reusable packaging

Recyclable packaging

More Wasteful

Excessive packaging

Small quantity of product per package

Packaging made from non-renewable resources (plastic)

Packaging made from virgin materials

Non-recyclable or difficult to recycle packaging

List three items brought into the class and describe a less wasteful method for packaging each item.

Item #1 How could it be packaged less wastefully?

Item #2 How could it be packaged less wastefully?

Item #3 How could it be packaged less wastefully?

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From Junk To Art

Use with Paper Recycling and Packaging Your Product.

Lesson Summary:

Using "throwaways" (items found in the trash or in junk stores, flea markets, and other places), students design, sketch, and create their own jewelry, sculpture or art pieces.

Key Concept:

Many things identified as "junk" or "garbage" can be used to create new objects that are attractive, useful, or whimsical.

Background:

Artists invite us to see the world around us in a different way. Many artists use "found" materials, or junk, in their artwork. In fact, artists are terrific recyclers!

Remi Rubel is a San Francisco artist who has made jewelry from things most people throw away. Her pins, necklaces and earrings are made from bottle caps, computer chips, safety pins and other items we find in the bottom of the trash can or at flea markets. She combines these items with photocopies of famous people to create contemporary whimsical jewelry. Her jewelry is so popular that it has been sold in boutiques.

Jo Hansen collected the litter she found on her windy street corner to provide a fascinating three-dimensional diary of life in her neighborhood.

William Wareham is a San Francisco sculptor who has used old heaters and scrap metal in his life-size sculptures. He haunted junk yards for the materials he used for this art. These individuals represent only a few examples of artists who use found materials in the Bay Area to create art. This lesson encourages us to take away the stigma that art is something only for "artists." Anyone can be creative and artistic by taking materials that are considered to have no value and turning them into something new and fun. With this new perspective, our garbage becomes a valuable resource.

Procedure:

1. Discuss with your students why artists might use found materials in their artwork. Point out that what some people consider "junk", an artist may perceive as valuable materials.

Vocabulary:

- artist
- jewelry
- sculpture
- scrap

Materials:

- several pairs of pliers
- metal awls
- hammers, nails (hardware store)
- clasp rings (found in any hobby store or bead shop)
- scissors
- wire cutters
- glue or epoxy
- one large cardboard box in which to put found objects

Continued on next page.

Materials Cont...

- Have students bring in any tools they may have at home.
- Creative "found" materials for students to bring in include:
  - paint bottle caps
  - plastic packaging
  - safety pins
  - old pens
  - marbles
  - glitter
  - nail polish
  - string
  - leather
  - fabric
  - pieces of plastic or metal
  - buttons
  - paper clips
  - leaves
  - sticks
  - yarn
  - old cards or magazines

2. Tell students to start collecting "found" materials of their own to bring in to class. Tell them to be creative, and list some of the items in the materials section above. Give them a week or two to collect things.

3. When everyone has brought in their found objects, have students show what they have collected. Let students trade and give away items as they wish.

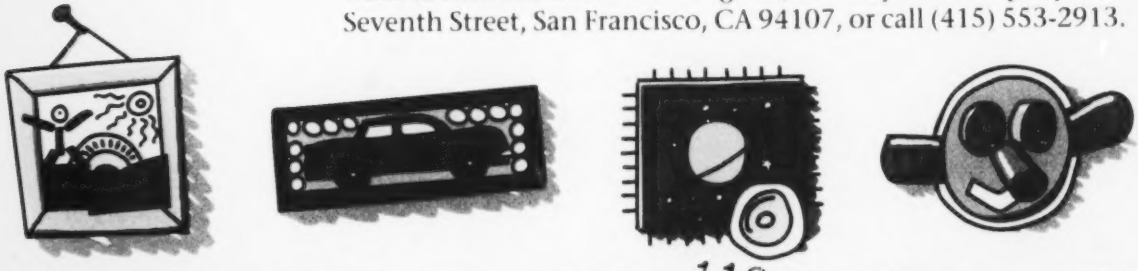
4. Each person should have several items on his or her desk. Have students take out a piece of scratch paper and sketch a design of a piece of art or sculpture using the chosen items. Don't worry about making a great picture, it is just a sketch to help figure out how to put things together. Remind students that they have to figure out how to attach items to each other. Will they use glue, clasp rings, or just bend pieces over and crimp them with pliers?

5. Using materials and sketches, students will now create objects with their own designs. Assist students with construction problems. When the basic sculptures are completed, your students can make decorations or backgrounds using any extra materials.

6. Display the finished products so that everyone can see each other's artwork.

Extension:

Turn your class into an art museum. Arrange art pieces on a shelf or wall. Make labels with each student's name and a title of the artwork. Invite other classes to come and visit the art show. See the Resources Section for names of guest speakers or books from which to get ideas. To receive a copy of "The Art of Recycling" that contains art and ecology projects for teachers, write to Artist-in-Residence Program, Sanitary Fill Company, 900 Seventh Street, San Francisco, CA 94107, or call (415) 553-2913.



Siting a Waste Incinerator

Precede with The Garbage of San Francisco.

Lesson Summary:

By participating in a mock public hearing, students examine the advantages and disadvantages of siting a solid waste incinerator. Students gain an understanding of a complex social, economic, and environmental decision-making process.

Key Concept:

Deciding where to build a place to recover natural resources and process discards is a difficult matter. There are many factors that must be considered in making an advised and responsible decision.

Background:

Every city and county in California is required to have a solid waste management plan that describes how every ton of solid waste produced will be handled and disposed of. Many issues are involved: safe and legal location of sites, public opinions, costs, environmental hazards, conservation of natural resources, job possibilities, increased revenue to the area, and traffic flow through the community.

The landfill is still the primary way we dispose of garbage. However, landfills are filling up rapidly and it is difficult, expensive, environmentally destructive, and time-consuming to develop new ones. An alternative is to reduce the volume of waste going to our landfills so they will last longer. Reducing the volume of waste can be accomplished in a variety of ways: shopping carefully, reusing and recycling materials, composting food and yard waste, and incinerating combustible trash. A combination of these approaches can bring our production of waste down by at least 75%. This combination of waste disposal methods is called Integrated Waste Management. Many cities are using the Integrated Waste Management approach to solve their solid waste dilemma.

However, the State and many cities in California have adopted a preferred waste management hierarchy. It states that source reduction (waste prevention and reuse) is the best method of managing wastes. Source reduction is followed by recycling and composting. The last option is landfilling and transforma-

Vocabulary:

- dioxin
- incinerator
- waste-to-energy
- pollution

Materials:

- "Incineration: Pros and Cons" Student Info Sheet
- "Public Hearing" Student Info Sheets

Save The Earth

Neighbors United

Waste-To-Energy

Environmental Quality Control

The City Council

tion, which includes incineration. San Francisco has adopted this hierarchy.

This role-playing activity helps illustrate the difficult and complicated issues surrounding siting of an incinerator.

Incineration/Waste-to-Energy Proposals for San Francisco

The City of San Francisco has looked at waste incineration options twice in the past. In 1983, proposals from two companies (Wheelabrator and Combustion Engineering) to site an incinerator in Brisbane were considered. These proposals were shelved after Brisbane residents voted against setting up an incineration facility in the city.

In 1987, a new proposal by Combustion Engineering for an incinerator in Redwood City was considered. This proposal was shelved primarily because the volume of waste required to operate the facility could not be guaranteed.

Procedure:

1. Divide the class into five groups. Four of the groups will represent specific interest groups testifying at this public hearing. The fifth group can represent the City Council whose responsibility it is to hear the testimony and make a final decision on siting the facility. Alternately, one could have the class elect the Council and then divide the rest of the students in four groups. Assign a role to each group and distribute the appropriate Special Interest Group Info Sheet. Give each group one copy of the "Waste Incineration: Pros and Cons" handout and the information sheet for the public hearing.

2. Explain that one representative from each group will present the group's position and concerns to the City Council. Each City Council member will be allowed to ask questions of the group following its presentation. Allow about 10 minutes for discussion and selection of a group spokesperson. Also select a person to write a brief position statement for each group. Depending on the amount of background information your students possess, you may wish to extend the lesson to allow further group work and /or library research before you proceed with the hearing. 21

3. When the groups are ready to make their presentations, assemble the entire class and have the City Council members sit facing them. The meeting is called to order by the City Council Chairperson. Each group's spokesperson presents a position statement lasting no more than five minutes.

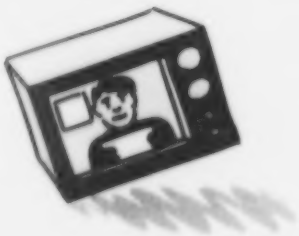
4. Allow about 10 minutes for general questions and discussion. The City Council must then vote on the proposal to site the incinerator.

5. After the role-play activity, ask your students what they learned from this experience. Was it easy for the City Council to come to a decision? Did everyone in the class agree with the Council's decision? What are the benefits and costs to the community? How did this affect how they view the decision-making process?

6. Be sure to point out that the best way to manage waste is through a combination of methods which may include reducing waste, recycling, composting, some waste-to-energy, and landfilling. This is called Integrated Waste Management and is the approach now being used to address the resource recovery and waste generation problems throughout the country.

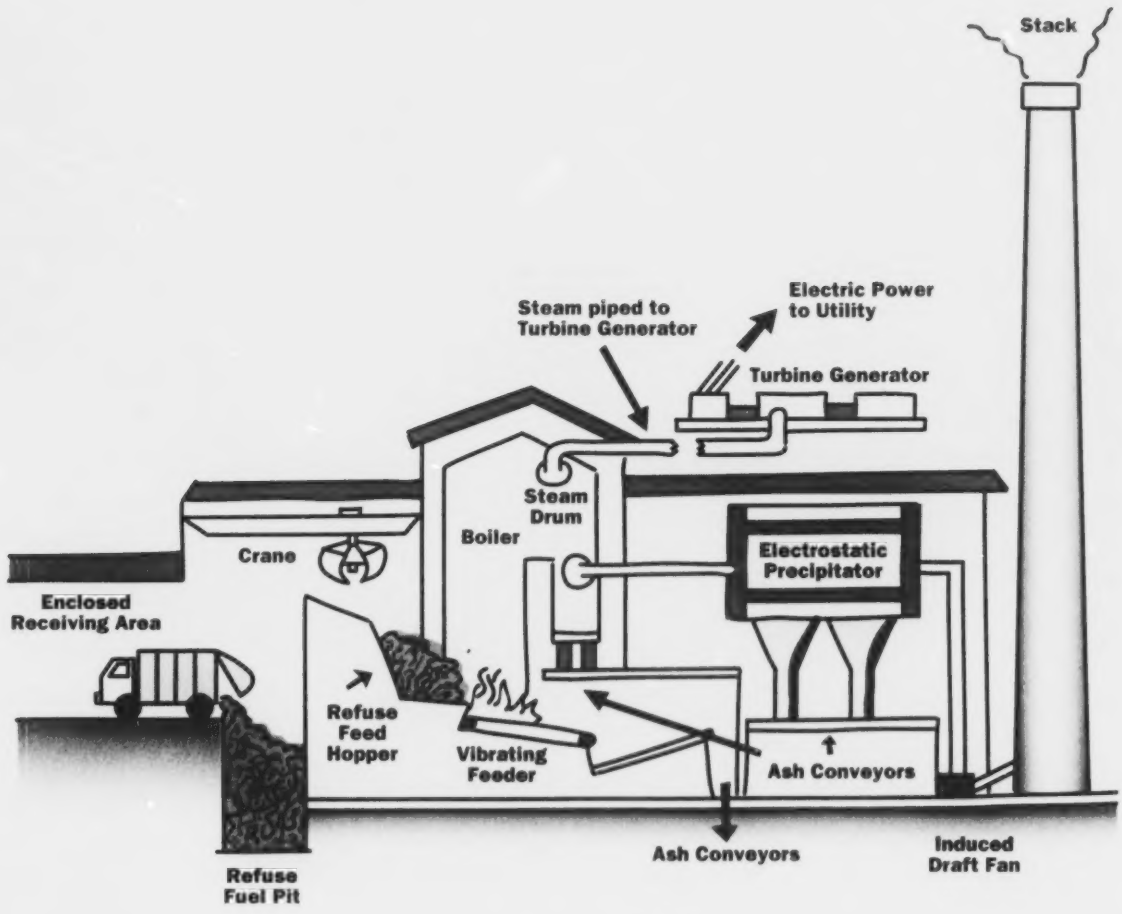
Extension:

- Have your students attend a real City Council meeting to see the decision-making process in action in their own community.
- Have students tune into cable stations broadcasting local and federal hearings.
- Encourage discussion on the advantages and disadvantages of this process for making decisions for the community.
- Discuss what sorts of recycling or solid waste facilities might be built in San Francisco and how the residents might react.



Student Info Sheet

A Waste Incinerator



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Student Info Sheet

Waste Incineration – Pros & Cons

PROS

- reduces waste volume
- extends life of landfills
- can produce energy
- can generate revenue from the sale of steam heat and electricity

CONS

- releases ash, CO2 (a greenhouse gas), and dioxin (a proven carcinogen) into the air increasing pollution
- is most expensive form of waste management
- operates generally for 15-20 years only
- produces toxic ash that is contaminated with heavy metals and other toxic materials, and that must be buried in a hazardous waste landfill.
- wastes resources as it only recovers their energy content not their "reuse" potential
- can discourage community from reducing, reusing , recycling, and composting. Some communities have had to burn valuable recyclables and even import waste to continue running the incinerator.
- is an inefficient method compared to recycling. (Recycling paper saves up to five times as much energy as can be recovered through incineration.)

There are two types of solid waste incinerators being used in the United States:

1) Mass burn facilities that do not separate recyclables either before or after burning.

2) Refuse-derived fuel (RDF) facilities that remove recyclables before the waste is burned.

Both mass burn and RDF facilities shred or process waste and burn it at high temperatures (up to 2500°F) to produce steam heat or electricity. Over 100 waste-to-energy plants or incinerators operate in the U.S., and nearly 100 more are in the advanced planning stage or under construction. Nationally, these plants burn about 14% of the country's solid waste. However as air and hazardous waste regulations for incinerators tighten and recycling systems become available and economical nationwide, fewer communities are choosing incineration.

Sources: *Closing the Loop*, Recycling Curriculum, Joseph H. Chadbourne, 1993
Conservatree Information Services, May/June 1992 *Rush To Burn*, Newsday, 1989

Student Info Sheet

A Public Hearing

City Characteristics:

Population: 100,000 residents

Waste generated: 450,000 pounds or 225 tons per day
82,125 tons per year

Residents generate approximately 40%, or 32,850 tons per year

Commercial sector generates approximately 60%, or 49,275 tons per year

(There is very little industry or tourism in the city.)

Your city faces a serious solid waste disposal problem. The City has neglected to plan ahead, and there are only four years of landfill capacity left. The City Council plans to build a mass bu" waste-to-energy facility or incinerator to solve the solid waste disposal problem in your town. It has also proposed a law that will require people to recycle certain items. Under the law, each household and business would separate aluminum cans and newspaper from the rest of its waste. These would be picked up and brought to a processing site near the facility, where they would be sorted and sold for recycling. The rest of the waste would be burned. Heat from the waste could be used to produce steam. In turn, the steam would be used on site or it could be sold to the local power company. The production of electricity would help pay for the cost of running the incinerator. As burning waste reduces its volume, the landfill would receive less waste each day. This would extend the life of the landfill for several more years.

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Student Info Sheet

A Public Hearing

SPECIAL INTEREST GROUP #1: SAVE THE EARTH

You are a member of the group that is opposed to the incinerator because:

1) Smoke and ash from the burning waste will contain toxic substances. You are especially worried about dioxins.

2) The town has not discussed the problem of toxics in the ash. After the waste has been burned, will ash be buried in the local municipal landfill where it would pose a threat to ground water, or hauled a long way to a special landfill for hazardous wastes?

3) There will be a large amount of dust and noise from the truck traffic.

4) Community members have not made a firm commitment to reduce their solid waste. Careful shopping, composting of yard and kitchen waste and recycling are all things people must start doing.

5) The projected life of an incinerator is about 15 years. What will people do with their waste after that?

6) Far more resources and energy could be saved through an aggressive recycling program that include residents, businesses, schools, government, and other institutions.

You support recycling but think the City Council has not gone far enough. You want the law to require separation of all glass, metal, and plastic food and beverage containers. You think the town should have a composting program. Perhaps the town should ban the sale of non-recyclable items in local stores.

Read and discuss the position that your group represents. Outline your presentation and choose one member of your group to speak to the City Council. Each speaker will have a limited time to speak (specified number of minutes set by City Council), and can submit written materials to support their case.

Student Info Sheet

A Public Hearing

SPECIAL INTEREST GROUP #2: NEIGHBORS UNITED

You are a member of a group of people who live in the neighborhood residential areas near to where the incinerator is to be built. You think the incinerator is fine, but not in your own neighborhood because:

1) You think that the presence of the incinerator will lower the value of your property.

2) The truck traffic will disturb your quiet neighborhood.

3) You are concerned about the effect of air and noise pollution on your family's health.

You are also against the proposed recycling program because:

1) Separating trash is too much work.

2) You have no place to store recyclables until they are picked up.

3) You are concerned that the recycling program will cost more money. You may have to pay more for your garbage pick up service or have increased taxes.

4) Putting all those recyclables on the curb looks ugly.

Read and discuss the position that your group represents. Decide whether or not you have an alternate solution. Outline your presentation and choose one member of your group to speak to the City Council. Each speaker will have a limited time to speak (specified number of minutes set by City Council), and can submit written materials to support their case.

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Student Info Sheet

A Public Hearing

SPECIAL INTEREST GROUP #3: WASTE-TO-ENERGY INC.

You are part of the engineering firm that plans to build the incinerator. You are in favor of the project because:

1) It will make a positive contribution to the community by reducing the amount of solid waste that needs to be landfilled. Electricity will be produced and can be sold.

2) The problem of toxic substances can be reduced by burning the waste at the proper temperatures.

3) Air pollution can be controlled by pollution control devices built into the smoke stacks.

4) Dust and noise can be controlled by building paved roads that go around, not through, residential areas. Construction of noise barriers such as rows of trees would also help.

Your company also favors recycling because both aluminum and newspaper can cause problems for the incinerator. Metals do not burn well. Newspaper inks contain heavy metals that contaminate ash. You know that selling these things will produce money to help pay for extra disposal costs. You would not oppose recycling even more items.

Read and discuss the position that your group represents. Outline your presentation and choose one member of your group to speak to the City Council. Each speaker will have a limited time to speak (specified number of minutes set by City Council), and can submit written materials to support their case.

Student Info Sheet

A Public Hearing

SPECIAL INTEREST GROUP #4: ENVIRONMENTAL QUALITY CONTROL

You work for the state agency that is responsible for managing solid waste. The agency is concerned about the disposal crisis in your town. You support the construction of a incinerator because:

1) The town cannot site a new landfill. Current landfill space is quickly filling up. An incinerator could significantly reduce the volume of waste coming into the existing landfill. This will extend the life of the landfill.

2) Energy recovery will help offset rising fuel prices.

3) The incinerator should not create pollution problems if extra money is spent to ensure the maximum pollution control devices are installed and that the plant is run properly.

You are also in favor of recycling because:

1) It saves natural resources.

2) The incinerator will last longer if recyclables are removed.

3) Residents are willing to recycle and should be encouraged to do so.

4) You would like to see all recyclables removed from the waste stream: metal containers, glass, recyclable plastic bottles, and all types of paper. This, combined with the incinerator, could reduce the amount of waste going to the landfill by 50%.

Read and discuss the position that your group represents. Outline your presentation and choose one member of your group to speak to the City Council. Each speaker will have a limited time to speak (specified number of minutes set by City Council), and can submit written materials to support their case.

Student Info Sheet

A Public Hearing

SPECIAL INTEREST GROUP #5: THE CITY COUNCIL

You are the elected members of the City Council. You must listen to all sides of the issue. Some groups have concerns about the construction of the incinerator. Others have reasons to support it. As they speak, you should take notes on the important points raised on all sides of the issue. It is your responsibility to decide whether or not to build the facility or to find a compromise or alternative. Your decision must be the best for all the people in your town.

Choose one member of your group to be the Chairperson. It will be that person's job to:

1. Call the hearing to order.
2. Describe the project.
3. Set a time limit for each speaker to present the group's position.
4. Call upon each group to present information supporting its position.
5. Allow the members of the City Council to question each speaker after he or she presents a position.
6. Keep the hearing moving and orderly.
7. Call for a vote of the Council members.

Glossary

Glossary

aerobic able to live and grow only in the presence ofoxygen

Algerian a person living in the city of Algiers, North Africa

aluminum a bluish, silver-white lightweight metal that can be bent or crushed easily and is highly resistant to rust

anaerobic able to live and grow without oxygen

ash the non-combustible residue that remains after burning

bacteria single celled living organisms; some break down solid waste

bauxite the principal ore of aluminum

biodegradable any material that will decompose as a result of the action of micro-organisms

buy-back a facility that purchases recyclable goods from the public

California Redemption Value (CA Redemption Value) items which carry this stamp can be exchanged at a recycling center or large supermarket for a specified sum of money

caution when seen on a product package, this word indicates that the product contains a slightly toxic substance; ingestion of one ounce or more is lethal to humans

cellulose a carbohydrate which is the chief constituent of the cell walls of plants used in the production of textiles and paper

competition when two or more organisms attempt to use the same resource

composition the different parts or elements that form a whole

compost organic material that has decomposed into a dark, earth-smelling, humus-like material containing nutrients and beneficial organisms

conservation planned management of a natural resource to prevent exploitation or destruction

consumption the utilization of goods that results chiefly in their destruction, deterioration, or transformation

corrosive a substance having the quality of burning or destroying other substances or tissue; a mild corrosive will burn eyes or skin

consumer one who consumes; one that buys products and services for personal use

crude existing in a natural state unaltered by cooking or processing

danger when seen on a product package, this word indicates that the product contains a high level of toxicity with a lethal dose being a few drops

decompose to undergo a chemical and physical transformation or breakdown; to break into smaller and smaller parts

dioxins part of a family of toxic chlorinated chemicals, emitted from incinerators as a result of inefficient combustion of carbon compounds. Also commonly generated during the paper bleaching process.

disintegrate to break up, to separate into component parts

disposable a product designed for single or short term use

ecology the scientific study of the relations of living things to one another and to their environment. A scientist who studies these relationships is called an ecologist. From the Greek "oikos" meaning house or home. Ecology is the study of our "home"- the earth, air, and water.

ecosystem a system made up of a community of living things and the physical and chemical environment with which they interact

element one of the substances of the earth that cannot be separated into simpler components by chemical means (See a periodic table of elements.)

emission odors or substances generated by combustion and discharged into the air

energy recovery heat released from combustion that is used to generate hot water, steam, electricity, or other energy forms

E.P.A. Environmental Protection Agency – the federal and state offices responsible for the environment (United States E.P.A. and California E.P.A.)

environment all the conditions, circumstances, and influences surrounding and affecting the development or existence of people or nature

explosive substance that explodes under certain conditions

flammable easily set on fire; combustible

garbage originally, spoiled or waste food that was thrown away; currently, any material considered worthless, unnecessary, or offensive – and usually thrown away

ground water water beneath the earth's surface in porous rock and soils that supplies wells and springs

habit customary use or practice

habitat the arrangement of food, water, shelter and space suitable to an animal's needs

hazardous wastes those wastes which provide special problems to living creatures or the environment because they are:
(a) poisonous,
(b) explosive,
(c) attackers or dissolvers of flesh or metal,
(d) readily combustible - with or without flame,
(e) carriers of diseases or,

(f) radioactive.
Some wastes cause only one problem. Others cause a combination of several of the above.

humus dark, spongy, earthy-smelling material resulting from partial decomposition of plant or animal matter that forms the organic portion of soil

junk anything regarded as worthless, or meaningless

incineration the process by which wastes are burned under controlled conditions

incinerator a furnace in which to burn or reduce to ashes

industrialist person who owns, or is concerned with the management of an industrial enterprise

infectious wastes wastes that cause biological disease or infections when in contact with living organisms

Integrated Waste Management coordinated use of a variety of waste management methods

landfill a place where solid waste is disposed of by spreading it in layers and covering it with soil

leachate liquid that drains out of an area; leachate from landfills contain decomposed waste, bacteria, and other contaminants

lethal dose the amount of a substance that causes death

lubricant a substance that reduces friction, especially in the moving parts of machinery

manufacture the making of goods or wares on a large scale by hand or by machinery

methane an odorless, colorless, explosive gas produced by the decomposition of solid waste under anaerobic conditions

mine an excavation made in the earth for the purpose of extracting ores, precious stones, and other natural resources

mineral naturally occurring homogeneous inorganic substance; a class of rocks with a specific chemical structure

natural resources a necessary or beneficial material source occuring in nature. Includes land, forests, mineral deposits, water, petroleum, etc.

nomad a person or group of people who have no long term residence in a single location, but instead move fequently in search of pasture or seasonal harvests

open dumping disposing of waste in open, uncovered areas

organic matter related to or derived from a living thing

organism a living thing

packaging the act, art, industry, process, or style of packing; containing a bundle of similar or identical items

PET polyethylene terephthalate, the plastic resin from which some plastic soda bottles are made (#1)

petroleum an oily, thick, flammable substance (usually a liquid),often dark-colored, that is a mixture of various hydrocarbons occurring naturally in various parts of the world, and commonly obtained by drilling

pollution harmful substances deposited in the air, water, or on land leading to a state of dirtiness, impurity, or unhealthiness

poison chemical substances that cause harm or death to living things

prototype the original or model on which something is based or formed

pulp moist fibrous materials from which, for example, paper and paperboard can be made

radioactivity the property possessed by some elements (such as uranium) of spontaneously emitting alpha or beta rays and sometimes also gamma rays by the disintegration of the nuclei of atoms

recyclability the degree of ease by which something can be recycled

recycle to pass through or undergo again, as for further treatment, change, or use

recycling the collection and reprocessing of manufactured materials for reuse either in the same form or as part of a different product

recycling center a site where manufactured materials are collected, processed, and resold for reprocessing
Types of collection at recycling centers are:
(a) drop-off - a center where materials are donated
(b) buy-back - a center where materials are purchased or redeemed

reduce to bring down to a smaller extent, size, volume, or number

refine to reduce to a purer state, to free from impurities

refuse something that is discarded as worthless or useless

renewable resource a resource capable of being replaced by natural ecological cycles or sound management practices, renewable resources include solar energy, wind power, falling water (hydroelectric), biofuels, fish and trees

replace to provide a substitute in the place of something

reuse to use again

scavenger a person that sorts through unwanted materials (or garbage) and collects items for resale and/or reuse

scrap an old, discarded, or rejected item or substance that is reprocessed or used as a raw material, such as old metal that is melted and reworked

sculpture the art of carving, modeling, or welding to produce figurative art in three dimensions

silica the dioxide form of silicon, SiO_2, used chiefly in the manufacture of glass, ceramics, and abrasives

synthetic a compound formed by chemical reaction in the laboratory as opposed to those of natural origin

transfer station a designated place where garbage is transferred from one place to another, usually from truck to truck

toxic poisonous; having the effect of a poison

toxicity the dosage of a substance that causes harm or death to a living organism

volume the amount of space, measured in cubic units, that an object or substance occupies

warning when seen on a product package, this word indicates that the product contains a moderately toxic substance with a lethal dose for humans being one teaspoon

waste garbage or refuse material

waste stream the continuous 'stream' of waste, refuse, and garbage that flows from homes, businesses, industry, government offices, etc. to landfills

Teacher Resource Section

The items listed below should be found in the pocket on the next page. The page numbers indicate where the materials are referenced in the curriculum.

page 21	Compost: the Inside Story brochure
page 25	a) DOC's "Trivia, Facts and Other Stuff" b) Resource Data Sheets c) Plastics Info Sheet
page 39	Garbage Graphs- National Percentages
page 81	a) "Garbage Cans and Garbage Can'ts" b) "Water Pollution Begin in Your Home"
page 125	Environmental Shopping Guide

For additional resource materials related to recycling or waste reduction, please call (415) 554-3400.

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Teacher Info Sheet

Plastics

The following list describes the seven major types of plastic resins.

#1	PET	**Polyethylene terephthalate** Plastic soft drink bottles, peanut butter, salad dressing, mouthwash, and spice containers.
#2	HDPE	**High-density polyethylene** Milk, water and juice containers, grocery bags, toys, liquid detergent bottles, motor oil containers.
#3	V	**Polyvinyl chloride or vinyl** Clear food packaging, most shampoo bottles.
#4	LDPE	**Low-density polyethylene** Bread bags, frozen food bags, grocery bags, mustard squeeze containers.
#5	PP	**Polypropylene** Ketchup bottles, yogurt and baby fruit juice containers, margarine tubs, medicine bottles.
#6	PS	**Polystrene** Videocassette cases, compact disc jackets, coffee cups, eating utensils, cafeteria trays, fast-food sandwich containers, grocery store meat trays.
#7	OTHER	**All other resins** Unmarked containers, lids, and mixed resins.

How are plastics made?

Plastic manufacturing involves two distinct processes and two separate industries. First, the plastic resin-production industry, composed mostly of very large chemical companies, converts industrial organic chemicals into plastic resins. Second, the plastic-processing industry, made up of thousands of smaller companies, extrudes, injects, blow-molds, and forms those resins into end products.

Plastic resins are made by linking small groups of molecules into long chains called polymers. Through polymerization, propylene is made into polyethylene terephthalate (PET), styrene into polystyrene, and vinyl chloride into polyvinyl chloride.

Chemical additives (added at either the resin-production or plastics-processing stage) transform a single resin into finished products that bear little resemblance to one another. They may be flexible or rigid; they may be transparent, opaque or colored; they may be easy to tear or as strong as steel. Unfortunately, many of these chemicals are toxic. Some of these toxic chemicals include benzene, cadmium compounds, carbon tetrachloride, chromium oxide, lead compounds, and styrene.

Aseptic Packages

In the last 5-10 years there has been a dramatic increase in the use of aseptic packaging, or drink boxes, in the United States. Many users of these containers are school age students. The box shaped containers are made with six separate layers that include paper, aluminum and polyethylene plastic. These various layers protect from exposure to air and light, and as a result the liquids inside the box are less likely to spoil. While the multiple layers of aseptic packages protect the liquids from spoiling, in order to recycle the containers the layers of different materials must be separated.

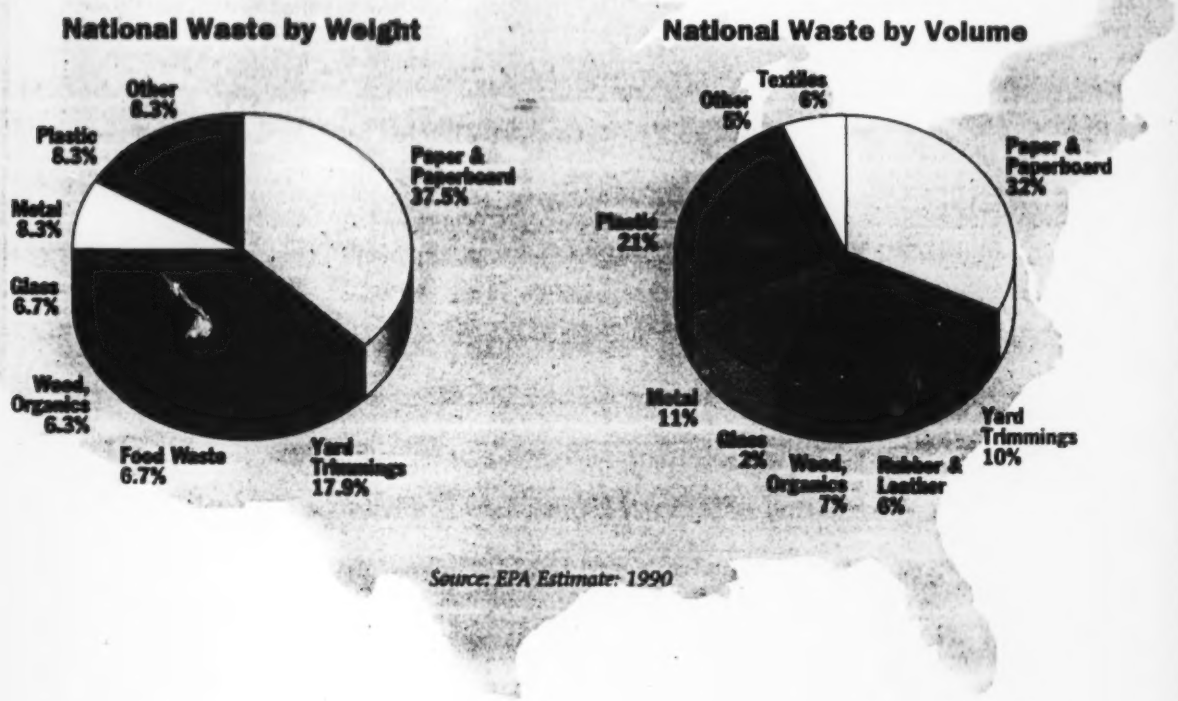
The primary method of recycling drink boxes is called hydropulping. Basically, boxes are cooked with water at high temperatures in a large vat. The plastic and the aluminum have to be separated out during this cooking process. The end result is a paper pulp which is reprocessed into new paper products. For each load of aseptic containers being recycled the yield of materials that are useful is approximately 40%.

Schools across the United States have also increased the use of milk (coated) cartons. The cartons are coated with a polyethylene plastic lining on the inside and outside. Similar to the recycling process for drink boxes, coated cartons are hydropulped too, the plastic is separated and the paper pulp is reprocessed into new paper products. For each load of coated cartons being recycled, the yield of useful materials is approximately 75%. Unlike drink boxes, however, the collection and storage of milk cartons for recycling can be problematic due to the odor of spoiled milk.

Source: A Plastics Packaging Primer,Environmental Action, July/August 1988

Teacher Info Sheet

Garbage - National Percentages



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U.S. Postage
PAID
San Francisco, CA
Permit No. 4

GARBAGE CANS

GARBAGE CAN'TS

CANS

You may dispose of small amounts of the items listed below with household garbage.

Containers that are 5 gallons or less with no continuous flow of liquid can be disposed of in the trash, as well as larger containers that are empty and dried.

Ceramic glazes (fire in kiln first)

Nail polish, if completely dried

Paints, if completely dried

Shoe polish, if completely dried

CAN'TS

Take the items listed below to the Household Hazardous Waste Collection Facility. Do not pour into sinks, drains, or street catch basins.

HOUSEHOLD ITEMS

Cleaning Supplies

Dry cleaning solvent
Furniture and floor polish
Household cleansers
Metal polish
Moth balls and flakes
Rug cleaners
Spot removers

Other

Aerosol cans
Batteries: re-chargeables & button cells
Butane lighters
Chemotherapy drugs
Flea powder
Lighter fluid
Mercury from a broken thermometer
Pet shampoo
Shampoo for lice
Shoe dye and polish

GARAGE/WORKSHOP ITEMS

Automotive Supplies

Antifreeze
Automotive cleaner
Auto body filler
Automatic transmission fluid
Brake fluid
Carburetor cleaner
Car batteries
Car wax
Chrome polish
Diesel fuel
Engine degreaser
Gasoline
Kerosene or lamp oil
Lubricating oil
Motor oil, used

Garden Supplies

Fungicides
Herbicides
Insecticides
Rat, mouse and gopher poison
Soil fumigants
Snail and slug poison
Vegetation killer
Weed killer

Painting Supplies

Acrylic paint
Latex-based paint
Model airplane paint
Oil-based paint
Paint stripper
Paint thinner, turpentine, mineral spirits

Other

Artist's mediums, thinners fixatives
Asbestos
Chemistry sets
Fluorescent lamp ballasts (PCBs)
Glues and cements
Needles and syringes
Photographic chemicals/ solutions
Resins, fiberglass, and epoxy
Rubber cement thinner
Wood preservatives

The following items cannot be discarded with household garbage. However, they do not need to be brought to the HHWCF. Small amounts of these products may be poured down the drain with lots of water. The empty container may then be thrown in the trash after rinsing three times.

Ammonia cleaners (never mix with other products)
Chlorine bleach (never mix with ammonia)
Cuticle remover
Hair remover
Disinfectants
Drain openers
Hair permanent solutions
Hair straightener solutions
Liquid medicine
Lye
Oven cleaner
Prescription medicine
Rubbing alcohol
Tub,tile, shower stall cleaners

San Francisco Household Hazardous Waste Program 554-4333

Thanks to: Sanitary Fill Company - Norcal Waste Systems Inc; SF Hazardous Waste Advisory Committee; SF Hazardous Materials Advisory Committee; Robin Dewey, American Lung Association of SF; Alameda County Household Hazardous Waste Program; Household Hazardous Waste Project - Southwest Missouri State University; Golden Empire Health Planning Center, Sacramento; Santa Clara County Hazardous Waste Management Program; Gina Ryerson, Non-Toxic Housecleaning Co-Op; Debra Lynn Dadd, Non-Toxologist

SOME THINGS DON'T BELONG IN OUR GARBAGE CANS

This guide explains how and where to properly dispose of household hazardous waste.

There was a time when household garbage was made up mostly of relatively organic things like table scraps and egg cartons. We cleaned the house with elbow grease, chased flies with flyswatters, and freshened the air by opening the windows. Today we live in a different world. Many of the products we use at home are made with harsh chemicals for fast results. Now we need to think twice about what we put in our garbage cans, because chemical waste from these products can harm our water and cause injury to people and animals.

THE HAZARDOUS PRODUCTS IN YOUR HOME

Just because you bought something at your neighborhood grocery or hardware store doesn't mean it's safe. Everyday products like oven cleaner, chlorine bleach, weed killer, and oil-based paints are hazardous and should be handled with caution.

For example, when ammonia and chlorine bleach are mixed together, toxic fumes are formed that can harm your lungs. This hazardous combination can also occur after the products have been discarded, posing a health hazard to sanitation workers.

The health risks associated with hazardous products don't go away once the trash is taken to the landfill. Containers, even sturdy ones, break when crushed under tons of garbage, potentially releasing toxic substances into our groundwater.

To the extent possible, we should substitute safe products for hazardous household chemicals. When it's necessary to buy products containing hazardous substances, buy only as much as you need and be sure to follow the directions on the labels for proper use, storage, and disposal.

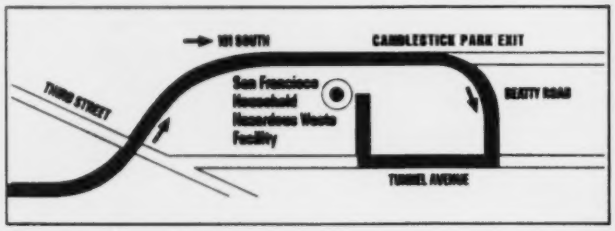
For large spills or other emergencies, call 911. For more information call the San Francisco Household Hazardous Waste Hotline: 554-4333.

USE THE HOUSEHOLD HAZARDOUS WASTE COLLECTION FACILITY

San Francisco has a Household Hazardous Waste Collection Facility (HHWCF), operated by Sanitary Fill Company, at 501 Tunnel Avenue near Candlestick Park. Residents of San Francisco may drop off hazardous waste at the facility free of charge. The hours of operation are **Thursday, Friday,** and **Saturday** from **8 a.m. to 4 p.m.**

FOLLOW THESE IMPORTANT GUIDELINES WHEN COMING TO THE COLLECTION FACILITY:

- Label all material. Do not mix materials.
- Make sure all lids are on tightly.
- If a container is leaking or dirty, wrap it in plastic and pack it in a large container with an absorbant material. Label outside container.
- Pack containers in a sturdy box or tub with newspaper or other absorbant materials and transport in the trunk or rear of your vehicle.
- Asbestos must be bagged in 6 mil. plastic bags (4 heavy garbage bags).
- Don't leave hazardous materials sitting in the sun or stored overnight in your car.
- Do not transport more than 5 gallons or 50 pounds of hazardous waste in your vehicle. State law strictly prohibits transportation of larger amounts without a license.
- You will be required to show proof that you live in S.F., so be sure to bring valid identification such as a utility bill or driver's license.
- When you arrive, stay in your vehicle. Trained personnel will remove the materials from your vehicle for you.



The Facility cannot accept:

- *Hazardous waste from businesses*
- *Radioactive materials (such as smoke alarms)*
- *Explosives*
- *Materials that are reactive with water or other substances such as calcium carbide*
- *Pressurized gas cylinders over 20 pounds*

WHAT YOU CAN DO TO HELP

It's up to each of us to help protect our environment by disposing of household hazardous waste properly. Here is a list of steps you can follow for handling hazardous products in your home:

- Take an inventory of the products stored in your home to identify hazardous substances.
- Use up these products so there is no hazardous "waste."
- Dispose of those products you no longer use according to the instructions in this guide.
- Post the *Cans and Can'ts* chart on the inside page in a handy place in your home. In the future, refer to the chart before discarding household cleaners, garden supplies, or other non-food items.
- Follow the suggestions in this guide for recycling and reducing the amount of hazardous household products you use.

REDUCE & RECYCLE

- **Buy only what you need.**
- **Read the product label. Choose products with clear directions on how to use. Follow the directions.**
- **Buy non-toxics or the least toxic products available.**
- **Use re-chargeable batteries which can be used over again.**
- **Buy only one general housecleaner rather than a variety of products for each purpose.**
- **Use the amount specified. Twice as much does not mean twice as effective.**
- **Use it all up. When you use all the product, there is no hazardous "waste" to deal with.**
- **When you can't use it, recycle it. Give extra paints to theater or civic groups, give extra house cleaning or gardening supplies to neighbors.**
- **Used motor oil, brake and transmission fluids, and antifreeze can be recycled at some gas stations. Call the Household Hazardous Waste Hotline at 554-4333 for the nearest gas station.**

The best way to protect your home and the environment from hazardous substances is to buy as few as possible in the first place. Here's a list of alternative house cleaning and garden products. Take it with you when shopping and check product labels for low or no toxicity.

Recycled paper, naturally

BUY ALTERNATIVES AND USE LESS

POTENTIALLY HAZARDOUS MATERIAL	ALTERNATIVE
General-purpose cleaners	Natural biodegradable cleaners such as Lifeline can be purchased in most health stores or dissolve 4 tsp. baking soda in warm water, then rinse well.
Heavy-duty cleaners	Vinegar and salt can be used as a surface cleaner. Or use Lifeline.
Drain cleaners	One-half cup white vinegar followed by one handful baking soda. Cover drain. Also try plunger or metal snake.
Oven cleaners	Use Lifeline. For a fresh spill, wet and sprinkle baking soda, scrub with soft nylon scrubber.
Pot and pan cleaners	Soak and clean immediately. Use baking soda and water. Scrub with steel wool.
Wall and floor cleaners	Mix vinegar and water. For floors use sour milk or skim milk in the rinsewater to polish.
Glass cleaners	Mix vinegar and water.
Toilet bowl cleaners	Sprinkle baking soda, then add vinegar and scour with toilet brush.
Tub and tile cleaners	Sponge down with vinegar and then add baking soda as a scouring powder. Or use Lifeline.
Chlorine bleach	Use dry bleach, a non-chlorinated bleach, or baking soda to whiten.
Furniture polish	Mix 1 tsp. olive oil with juice from one lemon and 1 tsp. water, or use mayonnaise.
Silver polish	Soak 5–10 minutes in 1 quart warm water, 1 tsp. baking soda, 1 tsp. salt, and a small piece of aluminum foil. Wipe with soft cloth. Or use toothpaste.
Spot removers	Immediate cold water and Lifeline. For Advanage, a non-toxic cleaner, call Austin Diversified Products at 1 (800) 822-5858.
Moth balls	Cedar chips, dried lavender, peppercorns. Store woolens in zipped plastic bags.
Rug cleaners	Rub lots of salt immediately on red wine spills, sprinkle baking soda then vacuum. Or use Lifeline.
Deodorant, hair sprays	Use manual pump or other non-aerosol containers.
Air fresheners	Ventilate. Open boxes of baking soda. Simmer cloves and cinnamon in boiling water.
Pesticides	For *ants:* Place sticky adhesive materials around base of plants and trees to deter ants. Wash counters with mixture of ½ vinegar and ½ water. For *cockroaches:* caulk cracks where they enter, mix equal parts of oatmeal flour and plaster of paris. For *fleas:* use flea combs or herbal flea powders. Vacuum house thoroughly. For *slugs* and *snails:* place copper-sheeting barriers around sensitive plants. For *flies:* use fly swatters, flypaper, or traps. For *summer biting insects:* rub vinegar or lotion on skin.

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Paper

THE HISTORY OF PAPER

The first paper was made about 300 million years ago by wasps. Wasps chew wood into a pulp and use the paste to make the walls of their houses. Humans began experimenting with paper-like substances only a few thousand years ago in an effort to find a more convenient writing and drawing surface than stone.

Animal skins were cleaned and pounded and stretched to make parchment. The inner bark from trees was peeled and pounded into thin sheets, and silk, woven into fabric, was also used as a painting surface. Papyrus reeds were also layered and pounded together to form lightweight sheets.

Paper gets its name from papyrus, but the two are made quite differently, though they both contain the key element of cellulose. Cellulose is the major building block of all plant cell walls. To make papyrus, whole plants were layered and pounded together. To produce a sheet of paper, cellulose is broken down into individual fibers by beating them and mixing them with water. The water is then drained away, leaving an interwoven mass of fibers in a thin sheet.

The first real paper was probably made by the Chinese in 105 AD out of mulberry tree bark, hemp, fishnets, and rags. The first European paper mill was built in Xativa, Spain in 1151 AD. The use of linen and cotton rags for making paper became commonplace in Europe.

Paper was made by hand by dipping screens into large vats of paper pulp and drawing out and draining a thin sheet of fibers. In 1799, the Fourdrinier brothers patented a machine which produced an endless roll of paper automatically. The paper-making machinery used today is basically the same as what was developed two centuries ago.

About the same time that the Fourdriniers were developing their machine, Matthew Lyon of Fair Haven, Vermont, had developed a method for making paper, not from used clothing fibers, but from the bark of the basswood tree and sawdust. Today most of the paper we use comes from trees, and the United States has become the largest producer and consumer of paper and paper products in the world.

FROM WHAT NATURAL RESOURCES IS PAPER MADE?

Wood that is unsuitable for use as lumber and lumber mill wastes is used to manufacture paper. The equivalent of approximately 17 trees is used to produce one ton of paper. Most of this fiber comes from fir and pine forests of the Northwest and pine forests of the South and Southwest. Hardwood forests of the north central U.S. and New England are also used. Approximately 3688 pounds of wood, 28 billion Btus of energy, 216 pounds of lime, 76 pounds of ash, 360 pounds of salt cake, and 24,000 gallons of water are used to make just one ton of paper.

Taken from *Teacher Resource Guide* by the Association of Vermont Recyclers
as it appears in *Closing the Loop* by the California Integrated Waste Management Board.

HOW IS PAPER MADE COMMERCIALLY FROM TREES?

To save transportation costs, paper mills are usually located near the forests where the wood is harvested. The trees are debarked, chipped, mixed with chemicals, and processed in a large steam-heated pressure cooker called a digester. This helps to break the wood down into cellulose fibers. The fibers are then rinsed with water to remove chemicals, unwanted wood contaminants, and dirt.

The remaining water-wood mixture, called slurry, is fed onto a screen and shaken to intermesh the cellulose fibers. Water is drained through the screen and the remaining sheet of paper passes through a series of rollers where it is pressed and dried. The continuous rolls of paper are produced by the machine at a rate of 30 feet per second and can be 16 feet wide.

WHAT EFFECTS DOES PAPER MANUFACTURE HAVE ON OUR ENVIRONMENT?

About 35 percent of the world's annual commercial wood harvest is used to produce paper, and this share is expected to grow to 50 percent by the year 2000. Although wood is a renewable resource, we are presently using more of our forest resources than we are replacing. U.S. Government subsidy of lumbering activity keeps the cost of wood products artificially low, encouraging their continued depletion.

In addition to depleting natural resources, paper manufacturing pollutes the environment. According to one estimate, producing one ton of paper creates 84 pounds of air pollutants, 36 pounds of water pollutants, and 176 pounds of solid waste. Disposing of used paper pollutes again, as litter, air pollution from burning, or groundwater contamination from leachate.

WHAT DO WE USE PAPER FOR?

Paper is used for three main purposes: (1) as a lightweight, durable surface for writing and printing, (2) to wrap and package food and other items, and (3) for sanitary products such as paper towels and tissue. In 1990, the United States consumed about 73 million tons of paper and paperboard products. Of this amount, approximately 52 million tons was thrown away, using up more landfill space than any other human-made trash.

WHY RECYCLE PAPER?

If we recycled half of the paper used in the world today we would meet almost three-quarters of the demand for new paper and as a result might arguably free 10 million acres of forest from harvest destined for the paper industry. As it stands, we waste about three-quarters of our used paper resources.

According to one estimate (which likely does not assess materials transportation and processing effects), when paper is made from waste paper instead of trees, 60 percent less water and 70 percent less energy are used, and 50 percent less pollutants are added to the environment.

Recycling also helps extend the life of our landfills. Nearly one third of our waste stream by weight and over half by volume is made up of paper. Recycling one ton of this waste saves an average of three cubic yards of landfill space.

HOW IS PAPER RECYCLED?

Waste paper must be sorted prior to recycling to ensure the best quality endproduct and to eliminate inks and adhesives which can damage machinery. Care must also be taken to store it out of sunlight and away from water which can break down cellulose fibers and make the paper unusable.

At recycling centers, paper is baled for shipping and transported to one of over 600 paper mills in the United States. At the mill, bales of waste paper are dumped into a pulper where a rotor mixes it with warm water and breaks the cellulose fibers back down into slurry. Plastic, wax, non-water-soluble glue, carbon, and similar substances which have not been removed in initial sorting will clog rotor sieves.

Once the rotor has thoroughly mixed the paper-water solution, a sieve catches contaminants such as paper clips and staples. The mixture then travels on through centrifugal cleaning tanks and is bleached and de-inked. Chemical de-inking can contribute to increased water pollution problems, as can loss of short paper fibers through screens.

Once cleaned, the slurry is deposited on screens, sent through rollers, and formed into the finished sheets of recycled paper in much the same way the original paper was made.

WHAT IS RECYCLED PAPER USED FOR?

Waste newspaper can be shredded and reused as animal bedding or packing material. Or it can be shredded, defibered, and treated with fire-resistant chemicals for use as building insulation.

Waste paper is usually recycled into a lower grade product than the original, as wood fibers break up and deteriorate. Hence, unlike aluminum and glass, a given quantity of wood fiber cannot be recycled perpetually. The following products are often made from recycled fibers: writing and printing paper and newsprint; roofing felt, insulation board, fiberboard, and other construction materials; fruit trays, flower pots, egg cartons, and other products molded from paper pulp; kraft paper; tissue; corrugated cardboard; and cardboard boxes.

IS RECYCLED PAPER AS GOOD AS PAPER FROM VIRGIN FIBERS?

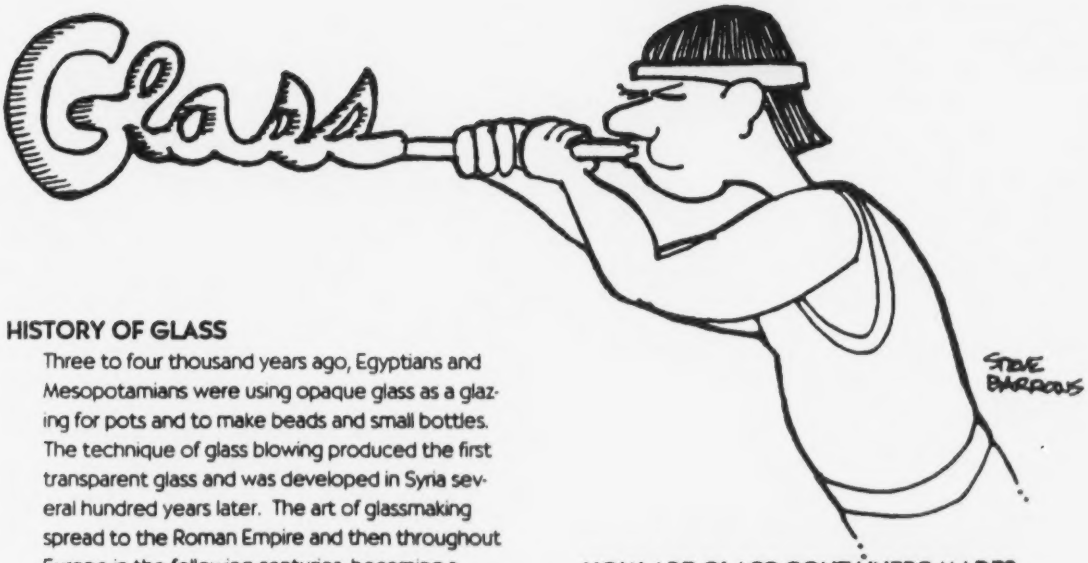
Some people think the quality of recycled paper is not as high as paper made from virgin materials. Printers cite problems with lint from short broken fibers causing a poor quality print, and a high moisture content causing paper-feeding problems. But according to Earth Care Paper Company, a vendeor of recycled paper, recycled paper is superior to paper made from virgin fibers because the fibers are more conditioned, the paper has greater flexibility, stands up better to humidity and temperature changes, has greater opacity, holds clay better, and is easier to feed on printing presses than nonrecycled papers.

A RECYCLING OUTLOOK

Recycling businesses operate in a hostile economic and political environment. Paper manufacturers often make product and packaging development decisions without regard to waste disposal and environmental cost and concerns. Freight taxes are lower for virgin materials than for recycled fiber. The forest industry is heavily subsidized through government tax policies and leasing of public land below cost to loggers. These artificial structures hide the real economic and environmental costs of using virgin material.

Of more than 500 paper mills in the U.S., over 75 percent use some recycled fibers. Over 200 use recycled fibers exclusively. The U.S. has also been exporting an increasing amount to other countries; between 1970 and 1986, exports of waste paper rose from 408,000 tons to 3,749,000 tons.

Sources: American Paper Institute. *RESOURCES*, Summer 1986. Earth Care Paper Company. *State of Vermont Solid Waste Management Plan.* Seymour and Girardet, 1987. Pollack 1987. Chandler, 1984.



HISTORY OF GLASS

Three to four thousand years ago, Egyptians and Mesopotamians were using opaque glass as a glazing for pots and to make beads and small bottles. The technique of glass blowing produced the first transparent glass and was developed in Syria several hundred years later. The art of glassmaking spread to the Roman Empire and then throughout Europe in the following centuries, becoming a widespread and highly crafted art form. The first known established glass house in America was founded in 1739 in New Jersey. Early glass factories in America mostly produced simple, useful glass objects such as window panes and bottles. The production of glass was not automated until the mid-nineteenth century.

FROM WHAT RAW MATERIALS IS GLASS MADE?

Approximately 1330 pounds of sand, 433 pounds of soda ash, 433 pounds of limestone, 151 pounds of feldspar, and 15.2 million Btus of energy are required to produce just one ton of glass. Major deposits of white sand suitable for making glass are found in Illinois, New Jersey, the Alleghenies, and the Mississippi Valley. Most soda ash comes from Wyoming, and 65 percent of the feldspar in the U.S. comes from California and North Carolina.

Soda ash (sodium carbonate) and cullet (recycled glass) are added to lower the melting point of silica and to create a good consistency. Limestone (calcium carbonate) is added to stabilize the mixture and keep it from dissolving in water. Different colored glass is produced by adding small amounts of other substances such as iron, copper, and cobalt. Green glass, for instance, is made by adding iron.

HOW ARE GLASS CONTAINERS MADE?

The entire mixture of ingredients used to make glass is called a batch. The batch is heated at temperatures reaching 2800 degrees Fahrenheit until the ingredients are completely melted and the mixture transparent. The batch is then cooled to about 1800 degrees Fahrenheit and the molten glass moved out of the furnace into a glass-forming machine which presses or blows it into its final shape.

In the glass-forming machine, compressed air pushes a gob of molten glass down into a mold. More compressed air is forced into the middle of the mold, pushing the glass out against its walls. The container is then transferred to another mold where one last blast of compressed air forms the rough container into its final shape. Finally, the containers are passed through a tunnel called an annealing lehr. If glass containers cool too quickly, they may shatter; annealing prevents breakage by passing the newly formed containers through a tunnel which reheats the glass and allows it to cool slowly.

HOW MUCH GLASS DO WE PRODUCE?

More than 43 billion bottles and jars are produced each year. Of this number 9 billion, or 21 percent of the country's total, were recycled. Each person in the United States uses almost 400 bottles and jars annually. However, glass production for beverage containers is decreasing as plastics become more popular. Another change is that refillable glass beer and soda bottles, which were once designed to handle up to 30 round trips from manufacturer to consumer, have become throwaway containers. This means that all the energy and raw materials used to produce the glass bottle are wasted, unless the bottles are recycled.

We can conserve resources by reusing glass at home, and industries would save energy by cleaning and refilling bottles, although this would be partially offset by the energy required for transporting and cleaning returned bottles. The next best thing after reusing glass is recycling. In 1981, only one in fifteen of the 46 billion bottles and jars produced was melted down along with fresh material to make new bottles and jars. By 1990 more than one in ten bottles and jars was recycled. Bottle bill legislation has recently substantially increased the amount of recycling of glass containers. Approximately seven out of every ten glass bottles covered by the bottle bill in California are returned and reused or recycled.

WHY RECYCLE GLASS?

Although the raw materials from which glass is made are plentiful, their collection and transformation into glass require a large amount of energy. It takes about 7600 Btus of energy to produce just one pound of glass. Also created in the production of just one ton of glass are about 385 pounds of mining waste and 28 pounds of air pollutants.

Using cullet saves energy because it melts at a lower temperature. For each 10 percent of cullet used, the furnace temperature can be lowered 10 degrees and the batch in most cases can be up to 83 percent recycled glass. Recently there have been developed several new glass manufacturing systems that use nothing but glass cullet. Using one ton of recycled glass will save 1.2 tons of raw materials. According to one estimate, by using 50 percent recycled glass in manufacturing new glass, water consumption can be cut in half, mining wastes cut 79 percent, and air emissions by 14 percent.

HOW IS GLASS RECYCLED?

To prepare glass for recycling, containers should be rinsed clean of any organic waste, aluminum and plastic caps and lead wrapping removed, and separated by color. Window glass, ceramics, pyrex, lightbulbs, mirrors, and other noncontainer glass should never be included because the different chemical compositions will cause visual inconsistencies and structural imperfections in new glass.

Once collected and separated into green, brown, and clear colors, glass is broken into very small pieces called cullet. The cullet is sorted to remove remaining contaminants such as metal and plastic caps, lids, and rings. Organic waste, ceramics, dirt, and rocks must be removed because they can cause flaws and impurities in the new glass. It is important for recyclers to collect only clean glass, because one damaged batch may eliminate a market.

Once collected and shipped to manufacturing plants, any remaining contaminants must be removed. Cleaned cullet is added to a batch of raw materials and melted in furnaces. Any remaining paper labels are burned off at this point. Once heated, the molten glass is poured into molds to form the new bottles and jars.

Cullet can be used to make fiberglass insulation, concrete, polymer-composited sewer pipe, brick, and terrazzo in addition to new beverage containers. It can also be used as a filler in paving, making a road surface called glassphalt.

Sources: *Oscars Options. Rhode Island Solid Waste Management Corporation 1985 Annual Report. Looking Good in Ohio Schools. Academic American Encyclopedia. RE:SOURCES,* Summer 1986. Worldwatch Paper 76. *RE:THINKING RECYCLING.* Phoebe Philips, *The Encyclopedia of Glass.* Midwest Regional Council.

Aluminum

WHAT IS ALUMINUM?

Aluminum is a silvery white metal which constitutes 8 percent of the earth's crust. It is the third most common element after oxygen and silicon. It is widely dispersed through most clays and rocks, most commonly as hydrated aluminum oxide. It is never found naturally in its metallic state.

There are several characteristics which make aluminum a valuable resource. It is light, strong, and while flexible, can be made more rigid by alloying it with small amounts of other metals. Because of its affinity for oxygen, it resists corrosion by forming a protective coating of aluminum oxide when exposed to air. Aluminum is a good thermal and electrical conductor.

FROM WHAT NATURAL RESOURCES IS ALUMINUM MADE?

The greatest concentrations of aluminum are found in bauxite ore, where it is found as alumina in combination with oxide, titania, and silica. Most of the world's bauxite reserves are located in the subtropics where heat and water weather away silica and other contaminants, leaving a higher percentage of aluminum.

Substantial bauxite deposits are located in Jamaica, Australia, Surinam, the former USSR, Guinea, France, Yugoslavia, Greece, and Hungary. The limited U.S. reserves are located in Arkansas, Georgia, and Alabama. The U.S. imports 85-90 percent of its bauxite.

HOW IS IT MADE INTO METALLIC FORM?

Surface mining of bauxite produces solid waste, energy, waterborne waste, air pollution and hazardous waste. Once taken out of the ground, it is transported to refineries around the world. It must then be refined into alumina. Approximately 55 percent of the world's aluminum is produced in the United States, the former USSR, Canada, Japan, and Germany.

The oxygen in the alumina is separated out through electrolysis, and combined with small amounts of other metals to strengthen it. The metal is then poured into bars called billets or blocks called ingots. It is then transferred to manufacturing plants which remelt and form the aluminum into various items.

The following resources are used to produce one ton of aluminum: 8766 pounds of bauxite, 1020 pounds of petroleum coke, 966 pounds of soda ash, 327 pounds of pitch, 238 pounds of lime, and 197 million Btus of energy. The pollutants created include: 3290 pounds of red mud, 2900 pounds of carbon dioxide, 81 pounds of air pollutants, 789 pounds of solid wastes.

WHAT DO WE USE IT FOR?

Aluminum is used in packaging, building, and automobile and aircraft construction. Other applications include electrical transmission, appliances, and other long-life consumer products.

WHY RECYCLE ALUMINUM?

Recycling aluminum saves 95 percent of the energy required to produce it from virgin materials. Recycling an aluminum can will save the equivalent in fuel of that can half-filled with gasoline. In addition, 95 percent of the air pollution is eliminated, and 100 percent of the solid waste is diverted from landfills.

HOW IS ALUMINUM RECYCLED?

According to Alcoa Aluminum Company, the turn around time for an aluminum can is only six weeks—from manufacturing the can, to filling it, delivering it to the store, being purchased, emptied, recycled by the consumer, shipped to a processing plant, made into cansheet, made into an aluminum can, shipped to the filler, filled, and shipped to the store.

Aluminum cans are 100 percent recyclable. Scrap dealers who receive aluminum from recycling centers sell recycled aluminum to smelters. The smelters must chemically analyze the aluminum they purchase, and shred and decontaminate it. Steel is removed from shredded aluminum as it passes over magnetized conveyor belts. Contamination of more than 1 percent non-aluminum metals makes the aluminum unusable in a smelter.

Once shredded and decontaminated, the aluminum scrap is melted for 18 hours, during which time impurities are removed periodically. The molten metal is then poured into forms and allowed to cool. The resulting ingots are transported to manufacturing plants, remelted and formed into new products.

A RECYCLING OUTLOOK

About 60 percent of aluminum cans are currently being recycled nationwide. Recycling rates are much higher in "Bottle Bill states". Californians recycle approximately 85 percent of their aluminum cans.

"Throughout the 1950s and 1960s, about 75 to 80 percent of all recycled aluminum was 'new scrap,' or industrial scrap, removed from fabrication plants. However, growing attention to environmental protection and energy conservation in the 1970s coupled with the enormous growth of aluminum beverage can recycling, made aluminum scrap an increasingly large proportion of the total aluminum supply. In 1984, about 30 percent of the total aluminum supply in the United States was scrap metal aluminum—two million net tons. Fifty-four percent was recovered by aluminum manufacturers during fabrication and 46 percent came from recyclers." (*Phoenix Quarterly*, Winter 1986.)

Other Metals

WHAT ARE IRON AND STEEL?

Iron is a naturally occurring pure chemical element. Steel is produced by adding carbon to iron. Other elements are added to this basic recipe to form different grades of steel. Steel is the most widely used metal today. After iron, the most widely used and recycled metals are aluminum, copper, zinc, and lead. Only about 30 pecent of all metal is recycled after its first use; most of the rest eventually becomes "waste." According to World Watch Paper 23, "after five cycles, only one quarter of the metal remains in circulation. After ten cycles, less than one one-thousandth of one percent remains."

WHAT ARE TIN CANS?

What we call "tin" cans are really steel cans with a very thin coating of tin. The tin protects the steel from corroding or rusting. Bimetal cans are tin cans with an aluminum top. They used to be common beverage containers throughout the country. They are less expensive to make than aluminum cans, but are not easily recyclable because they are made from three metals which must be separated again for recycling. You can tell the difference between tin (steel) cans and aluminum with a magnet. Magnets will attract steel but not aluminum. Tin and bimetal cans both attract magnets.

WHY RECYCLE SCRAP METAL?

In the last 20 years the production of steel from scrap has increased about 20 pecent while raw steel production has declined. During the last 10 years, improved steelmaking technologies, which yield less scrap, have increased the demand for purchased scrap by more than 50 percent. The overall recycling rate of steel products in the U.S. is 66 percent. Small mills which use electric furnaces to produce specific products from scrap are called mini-mills. They bypass the initial stages of mining and processing ore and proceed directly to the fabrication of new products. By doing this they are able to save lots of energy and expense. Mining iron ore and producing steel is hard on the environment and energy-intensive. Using scrap instead of iron ore to make new steel reduces air pollution by 86 percent and water pollution by 76 percent, saves 74 percent of energy and 40 percent water used, and can reduce the need for virgin materials by 90 percent.

A RECYCLING OUTLOOK

Large magnets are used to remove ferrous contaminants from aluminum scrap and to isolate ferrous scrap from mixed waste at material recovery facilities. In California, curbside collection of steel cans is increasing in residential communities. Most of these cans collected are exported to states like Utah and Montana and are used in the copper mining industry.

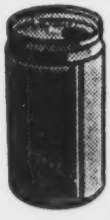
Large scrap iron found in white goods, such as old stoves and refrigerators, are shredded at California ports and are exported to Pacific Rim countries.

Sources: Pollack, 1987. *State of Vermont Solid Waste Plan, 1988.* Institute of Scrap Iron and Steel, Inc.

TRIVIA, FACTS AND OTHER STUFF

The numbers following each trivia piece correspond to the numbers in the "Works Cited" section.

ALUMINUM:



Recycling 1 ton of aluminum saves the equivalent of 2,350 gallons of gasoline. This is equivalent to the amount of electricity used by the typical home over a period of 10 years. *(17)*

Americans throw away about 35 billion aluminum cans every year. If all of these cans were recycled, we would save an amount of energy equivalent to 150 Exxon Valdez oil spills annually. *(29)*

Americans discard enough aluminum to rebuild our entire commercial air fleet every 3 months. *(1)*

Using recycled aluminum beverage cans to produce new cans allows the aluminum can industry to make up to 20 times more cans for the same amount of energy. *(3)*

If aircraft carriers were made of aluminum beverage cans, more than 15 aircraft carriers could have been built in 1992 from the 1,070,331 tons recycled. *(3)*

The aluminum beverage can returns to the grocer's shelf as a new, filled can in as little as 90 days after collection, remelting, rolling, manufacturing and distribution. Consumers could purchase the same recycled aluminum can from a grocer's shelf every 13 weeks or 4 times a year. *(3)*

Every minute of every day an average of 119,292 aluminum cans are recycled. *(3)*

According to the U.S. Environmental Protection Agency (EPA), aluminum cans represent less than 1% of the nation's solid waste stream. *(3)*

Aluminum can recycling saves 95% of the energy needed to make aluminum from bauxite ore. Energy savings in 1992 were enough to light a city the size of Pittsburgh for 6 years. *(3)*

It's estimated that since 1972 some 13 million tons of aluminum cans have been recycled. These 534.7 billion aluminum cans placed end-to-end could stretch to the moon some 170 times. *(3)*

Recycling a six-pack of aluminum cans could save enough energy to drive a car 5 miles. One can equals the amount of energy a can half-full of gasoline would produce. *(26)*

One recycled aluminum can saves enough electricity to operate a TV for 3 hours. *(28)*

COMPOST:

In test corn plots in Minnesota, fields treated with both compost and fertilizer achieved yields 17% higher than fields spread with only commercial fertilizer. *(23)*

In the U.S., yard trimmings and food scraps make up about one-fourth of our waste stream. Composting is an effective way to decrease landfills. *(29)*

In Sacramento County, 150,000 cubic yards of grass clippings (or the equivalent of a 7 story building the size of a football field) are sent to landfills every year. *(25)*

Americans throw away about 10% of the food they buy at the supermarket. This results in dumping the equivalent of more than 21 million shopping bags full of food into landfills every year. *(10)*

One pound of red worms can consume half a pound of food waste every day. *(15)*

GLASS:

Recycling 1 ton of glass saves the equivalent of 10 gallons of oil. *(17)*

About 75% of the United State's glass is used for packaging. *(10)*

Americans throw away enough glass bottles and jars every 2 weeks to fill the 1,350-foot towers of the World Trade Center in New York. *(10)*

Most bottles and jars contain at least 25% recycled glass. Glass never wears out — it can be recycled forever. *(10)*

Recycling a glass bottle saves enough energy to light a 100-watt bulb for 4 hours. *(26)*

LANDFILLS:

The EPA predicts that by the year 2000, less than half of the remaining 6,000 municipal landfills in the U.S. will still be in use. *(12)*

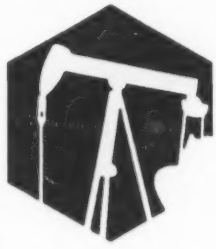
Landfill gas has been used to carbonate soft drinks. *(10)*

We dump most of the magazines printed in the U.S. each year (about 8 million tons) into landfills. If we recycled just half of them, we could save over 12 million cubic yards of landfill space. *(10)*

The largest landfill in the world is located in rural Alabama. *(13)*

More than two-thirds of the material going into landfills is degradable. However, very little change occurs because moisture is the most important environmental variable of degradation. Landfills are kept as dry as possible to help prevent groundwater contamination from runoff. For example, newspapers are still readable more than 20 years after being thrown away. Food, such as T-bone steaks and hot dogs, remain relatively unchanged for more than a decade. *(7)*

OIL:



The world will need twice the raw materials in 2010 that it does today. Maintaining the same level of oil usage, will require discovering as much in the next 10 years as has been found in all of history. *(19)*

A quart of motor oil can pollute 250,000 gallons of water. *(10)*

Americans throw away enough used motor oil every year to fill 120 supertankers. *(10)*

One quart of oil has the potential to pollute 1 acre of land 1 inch deep. *(26)*

Do-it-yourself oil changes in the U.S. produce at least 200 million gallons of used oil each year. More than half of it is wasted. Recycling can provide enough power for 360,000 homes a year or produce 96 million quarts of high-quality motor oil. *(6)*

It is easier and cheaper to recycle used oil than to make new oil from crude. One gallon of used oil can produce the same amount of motor oil as 42 gallons of crude oil — while requiring about a third of the energy. *(6)*

PAPER:

If you're an average American, it's going to take 465 trees to provide you with a lifetime of paper. *(31)*

Americans throw away the equivalent of more than 30 million trees in newsprint each year. *(10)*

Americans discard 4 million tons of office paper every year. That's enough to build a 12 foot-high wall of paper from New York to California. *(10)*

In 1988, Americans used enough kraft paper for a person to take a brown bag lunch to school or work for 64 million years. *(10)*

The averages for white paper recycling in educational institutions were: high schools—5.3 pounds per student; middle/junior high schools—2.91 pounds per student; and elementary schools—1.41 pounds per student. *(32)*

If Americans recycled their phone books for a year, an estimated 650,000 tons of paper could be saved. *(10)*

Recycling half the world's paper would free 20 million acres of forest land. *(10)*

Recycling one stack of newspapers about 6 feet tall saves the life of one tree 35 feet tall. Recycling approximately 1 ton saves 17 trees. *(26)*

If you stacked up all the paper an average American uses in a year, the pile would be as tall as a two-story house. *(9)*

The junk mail Americans receive every day could produce enough energy to heat 250,000 homes for 1 day. *(18)*

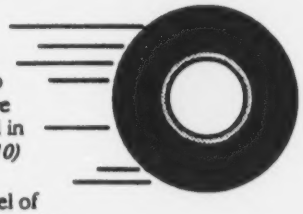
Americans use about 30 billion cardboard boxes a year. That's enough to make a pile as big as a football field and as high as the World Trade Center in New York. If every person in America recycled just 1 box a month, more than a billion boxes a year could be kept out of landfills. *(18)*

In 1988, about 9 million steel automobile bodies — more than the U.S. auto industry produced that year — were recycled. *(10)*

Americans use 100 million steel cans a day. We throw away enough steel every year to build all the new cars made in America. *(18)*

Making tin cans from recycled steel takes only one-fourth of the energy needed to make them from new steel and creates only one-fourth of the water and air pollution created by making cans from new steel. *(18)*

TIRES:



An estimated 2 to 3 billion tires are currently stockpiled in the United States. *(10)*

It takes half a barrel of crude oil to produce the rubber in just 1 truck tire. *(10)*

Putting old tires around tomato plants can help the plants grow faster. *(10)*

People in Third World countries know the value of used tires. In India, they cut up tire scraps to make inexpensive shoes. *(10)*

About eight out of every ten tires in the U.S. wind up in landfills or "stockpiles." *(10)*

At one site near Modesto, California, 42 million tires are stockpiled. "Mount Goodyear," as it is nicknamed, is still climbing at 20,000 tires a day. *(26)*

One discarded tire can produce sufficient electricity for one home for a day. *(28)*

Artificial reefs, breakwaters and erosion control barriers made with whole tires can preserve precious natural habitats. *(27)*

WASTE:

In 1987, Americans generated almost enough trash to fill a 24-lane highway 1 foot deep from Boston to Los Angeles. *(5)*

In the United States we throw away 18 billion disposable diapers per year at a cost of 15-35 cents a piece (diaper services only charge 7-20 cents per diaper). *(17)*

In the United States we throw away the same amount of trash per person as we did in 1910 (a lot of coal ash was produced from heating homes). *(17)*

Americans throw away enough aluminum to rebuild the entire American air fleet 71 times, enough steel to reconstruct Manhattan and enough wood to heat 5 million homes for 200 years. *(26)*

In 1990, cities in California paid over $1 billion to get rid of their trash. Some cities have resorted to shipping their waste hundreds of miles away. Developing countries are being contracted as dumping grounds for U.S. trash. *(15)*

Americans represent only 5% of the world's population, but generate 30% of the world's garbage. *(30)*

In the United States we throw away enough garbage per day to fill 63,000 garbage trucks which hold 7-14 tons of trash. On an annual basis, we fill up enough garbage trucks to form a line that would stretch from earth halfway to the moon. *(17)*

Estimates indicate that over 14 billion pounds of trash are dumped into our seas each year by commercial and recreational boats. *(1)*

In a lifetime, the average American will throw away 600 times his or her adult weight in garbage. If you add it up, this means that a 150 pound adult will leave a legacy of 90,000 pounds of trash for his or her children. *(10)*

United States waste disposal is expected to cost $100 billion by the year 2000. *(10)*

The average baby generates a ton of garbage every year. *(10)*

For every $1,000 of fast food sales, 200 pounds of trash is created. *(26)*

Every day the average person creates 5 - 6 pounds of trash. *(26)*

Californians create about 46 million tons of trash every year, enough to fill 2 freeway lanes 100 feet deep from Oregon to Mexico. *(26)*

Americans make more than twice as much trash per person as people of other countries such as Japan and Germany. *(26)*

Of the garbage Americans throw out, half could be recycled. That's enough to fill a football stadium from top to bottom every day. *(15)*

If you and your family recycled a ton of writing paper, you would save as much as 7,000 gallons of water. How much water is that? You would have to drink 130 glasses every day for more than a year to get that much water. *(18)*

The EPA has found that making paper from recycled materials results in 74% less air pollution and 35% less water pollution. This means that every ton of recycled paper keeps almost 60 pounds of pollutants out of the atmosphere that would have been produced if the paper had been manufactured from virgin resources. *(20)*

More than half million trees are used to produce the 88% of Sunday newspapers that are never recycled. *(11)*

Every ton of recycled paper saves approximately 4 barrels of oil, 4200 kilowatt hours of energy and enough energy to heat and air-condition the average North American home for almost 6 months. *(28)*

PLASTICS:

Plastics are made from petroleum—a limited, nonrenewable resource. It is predicted that by the year 2040, the Earth's usable petroleum reserves will have been depleted. *(29)*

If the Pilgrims had six-packs, we'd still have the plastic rings from them today. *(10)*

It takes 1,050 recycled milk jugs to make a 6-foot plastic park bench. *(10)*

Although polystyrene foam is completely non-biodegradable, it is recyclable. *(10)*

If you lined up all the polystyrene foam cups made in just one day, they would circle the earth. *(9)*

Plastics are the fastest growing share of the U.S. wastestream accounting for 5% of household throwaways. Every American uses almost 200 pounds of plastic in a year — 60 pounds of it for packaging. *(26)*

According to Dr. Jack Milgram, a plastics analyst, "Recycling plastics saves twice as much energy as burning them..." *(26)*

In 1987, the U.S. used almost 1 billion barrels of oil (enough to meet the nation's oil demand for imported oil for 5 months) just to make plastics. *(26)*

When buried, some plastic materials may last for 700 years. (Manufacturers add inhibitors that resist the decomposition process necessary to break down the plastic.) *(26)*

Over 46,000 pieces of plastic debris float on every square mile of ocean. *(26)*

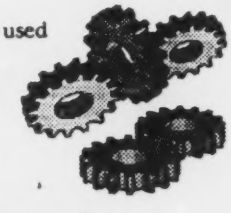
Americans use 4 million plastic bottles every hour! – yet only 1 bottle out of 4 is recycled. *(18)*

Americans make enough low density polyethylene (LDPE) plastic every year to shrink-wrap the state of Texas. Most of it ends up in landfills. *(18)*

Plastics are part of the wastestream: although they account for only 8% of the waste by weight, they occupy about 20% of the volume in a landfill due to their low bulk density. *(11)*

Being inert, plastic bags do not emit methane gas or liquid leachate—two common environmental problems of improperly managed landfills. *(21)*

STEEL:



About 70% of all metal is used just once and then discarded. The remaining 30% is recycled. After 5 cycles, only one-fourth of 1% of the metal remains in circulation. *(16)*

Every year enough energy is saved by recycling steel to supply Los Angeles with nearly a decade's worth of electricity. *(10)*

Every day Americans use enough steel and tin cans to make a steel pipe running from Los Angeles to New York and back again. *(10)*

Americans use 100 million tin and steel cans every day. Every minute, more than 9,000 tin cans are recovered from the trash with magnets. *(10)*

During the last decade, world steel makers recycled almost 2.5 billion tons of steel. *(10)*

MISCELLANEOUS:

Only about one-fourth of the paper, aluminum, iron and steel used in the world is recovered for recycling. *(4)*

Only Japan and the Netherlands collect more than half of their aluminum, paper and glass for recycling. In effect, these two countries require no raw materials for making paper and glass every 1 year out of 2. *(23)*

Our Litter & Its Decomposition Time:

- Glass Bottles/Jars 1,000,000 years
- Aluminum Cans 80-100 years
- Rubber Boot Soles 50-80 years
- Leather Items up to 50 years
- Nylon Material 30-40 years
- Plastic Bags/Disposable Diapers 10-20 years
- Plastic Coated Paper 5 years
- Wool Cap 1-5 years
- Cigarette Butts 1-5 years
- Orange and Banana Peels 2-5 weeks
- Newspaper 2-4 weeks

(24)

An average American uses 8 times the natural resources of the average world citizen — and produces 5 times the air pollution of the average world citizen. *(31)*

The world's forests are being destroyed at the rate of 1 acre per second. Every 16 minutes, a forest the size of New York's Central Park is destroyed. Every day, a forest the size of Philadelphia (74,000 acres) is lost, and every year, an area the size of Pennsylvania (27 million acres) is ruined. *(5,31)*

To date, scientist have named 1.4 million species of plants and animals, but estimate that between 5-30 million share our planet. Tropical rain forests, which are home to about half of all Earth's plant and animal species, are being destroyed at the rate of 100 acres per minute. *(29)*

Rechargeable batteries cost more than disposable batteries, but they save money in the long run because they can be recharged up to 1000 times ! If you take care of them, they can last up to 10 years ! *(18)*

Sixty percent of the world's lead supply comes from recycled car batteries. Virtually 100% of the car batteries returned to gas stations and battery dealerships get recycled. *(10)*

In 1989, enough scrap copper was recycled in the U.S. to supply the wiring and plumbing for every building constructed already that year. *(10)*

Recycling has created an estimated 30,000 jobs since 1970. In 1985, an estimated 2 million aluminum can collectors earned over 200 million dollars for their recycling efforts. *(2)*

HISTORICAL PERSPECTIVES:

Napoleon III is reported to have been the aluminum industry's first customer. The French emperor backed Henri-Etienne Sainte-Claire Deville's chemical extraction experiments. Deville developed a practical way to produce aluminum chemically. When the experiments produced the first aluminum in any quantity, it went into a rattle for the emperor's son. *(14)*

Napoleon had dinnerware made of aluminum. At this time, less important guests had to use gold and silver. *(14)*

The first "architectural" use of aluminum was the cast 100-ounce tip of the Washington Monument (which is still in place). *(14)*

The all-aluminum can was introduced in 1964. *(10)*

The biggest advance in glass manufacturing prior to the 19th century occurred in 200 B.C. when Babylonian craftsmen discovered the art of glass blowing — an art used until the 20th century, when even window glass is still being blown. *(22)*

In the mid-1930's, the first "sanitary landfills" were built in California and New York. These were really only open pit dumps, covered with dirt regularly to hide trash and cut down on flies, rats and odors. *(10)*

From the time of its development in 105 A.D. by the Chinese civil servant, Ts'ai Lun, to the early 19th century, the raw material of paper was rags. A chronic shortage of rags developed toward the end of the 18th century. More people were reading, more books were being printed and, consequently, the price of paper rose while the supply diminished. The results of the shortage were new papermaking methods: In 1802, Mathias Koop began making paper from straw and various wood pulps and on it printed a history of paper. In 1844, the mechanical pulper was developed; a chemical process followed ten years later. Once pulp could be made in large quantities, papermaking machines were quickly developed and trees began to be "digested" in large quantities. *(22)*

In 1868, John Wesley Hyatt invented the first plastic (celluloid) to make billiard balls during an ivory shortage that threatened the billiard industry.

In 1955, the Corvette became the first car built with plastic body panels. *(8)*

In 1982, the U.S. Army started using a helmet made of a plastic composite called Kevlar® — the same material in bulletproof vests used by police officers. The plastic helmet is about 30% more effective at stopping shell fragments. *(8)*
®Trademark of E.I. DuPont & Company, Inc.

Photographic film made with celluloid (one of the first plastics) was perfected in the late 1800's. Celluloid film led to a new era in entertainment, the motion picture. *(8)*

In 1989, more than 90,000 African elephants were killed for their ivory. Even when most countries prohibited commercial trade of ivory, poaching still occurred. However, the increased use of plastic as an ivory replacement has reduced the demand and price of ivory, making poaching less profitable. *(8)*

During the raw materials shortage of World War II, virtually all of the world's silk was used up in the war effort. As a result, women's silk stockings were replaced with nylon stockings. Today, we just call them "nylons." *(8)*

During World War I, reducing the weight of bicycles saved 2,000 tons of steel. *(10)*

By 1915, 89% of all major U.S. cities had municipal garbage collection service. *(10)*

Curbside recycling originated in 1874 in Baltimore. *(10)*

The compacting garbage truck, called the "Packer," was introduced in 1950. *(10)*

The first incinerator was commissioned in New York City in 1885. *(10)*

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RESOURCES

MORE COMPOSTING BROCHURES

- *Composting Fruit & Vegetable Trimmings*
- *Compost Bins – Sources & Designs*

COMPOST EDUCATION CENTER

Stop by SLUG's Garden for the Environment at 7th Ave. and Lawton! The Center features compost bins and how-to signs. Open all daylight hours.

FREE WORKSHOPS

Sign up for our basic and worm composting workshops! Call the Rotline for a current schedule.

BOOKS

Backyard Composting, 1992. Harmonious Technologies, Harmonious Press, Ojai, CA, 96 pp.

Let It Rot!, 1975. Stu Campbell, Garden Way Publishing, Pownal, VT, 144 pp.

Rodale Book of Composting, 1992. G. Gershuny, Saint Martin's Press, New York, NY, 278 pp.

Worms Eat My Garbage, 1982. Mary Appelhof, Flower Press, Kalamazoo, MI, 100 pp.

THE ROTLINE (415) 285-7585
RECYCLING HOTLINE (415) 554-6193

ABOUT THE S.F. RECYCLING PROGRAM

The San Francisco Recycling Program, operated by the City and County, offers services in curbside and apartment recycling, commercial recycling, school education, organics recovery, reuse, waste reduction and market development for recyclables.

ABOUT SLUG

SLUG greens the City, brings neighbors together in community gardens, provides employment and training to low-income communities, and teaches home composting and gardening. Join SLUG to support these efforts and receive free seeds, supplies, and discounts at local nurseries.

SAN FRANCISCO LEAGUE OF URBAN GARDENERS
2088 Oakdale Avenue, San Francisco,
CA 94124 • (415) 285-SLUG

The Home Composting Program is sponsored by the Recycling Program of the City and County of San Francisco

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BASIC COMPOSTING

TURN YOUR GARBAGE INTO GOLD! IT'S EASY, IT'S SMART, IT'S RECYCLING.

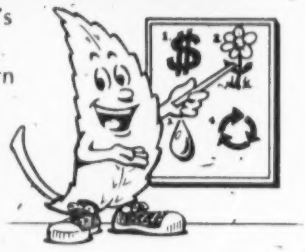
SAN FRANCISCO
HOME COMPOSTING
PROGRAM

San Francisco League of Urban Gardeners

San Francisco RECYCLING PROGRAM

WHY COMPOST?

Composting is nature's way of recycling. It is a satisfying way to turn your fruit, vegetable and yard trimmings into a dark, crumbly, sweet-smelling soil conditioner.



COMPOSTING:

- **Saves you money** by lowering garbage bills and replacing store-bought soil conditioners.
- **Helps garden and house plants** by improving the fertility and health of your soil.
- **Saves water** by helping the soil hold moisture and reducing water runoff.
- **Benefits the environment** by recycling valuable organic resources and extending the life of our landfill.

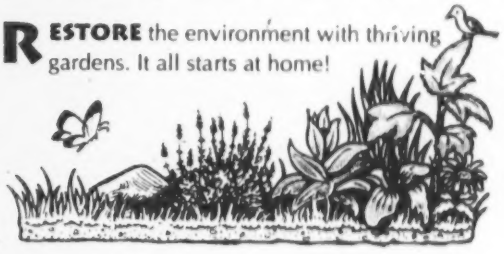
THE 4 "R'S" OF THE YARD

REDUCE the amount of yard trimmings you make by planting slow-growing, drought-tolerant plants.

REUSE yard trimmings by grasscycling (mowing more often, and leaving the clippings on the lawn) and by mulching fallen leaves and chipped prunings (spread them 6" deep on paths and around trees and shrubs).

RECYCLE remaining yard trimmings by *composting*. This brochure shows you how.

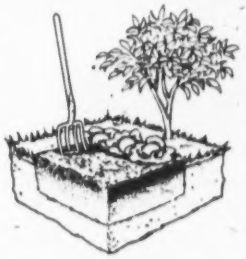
RESTORE the environment with thriving gardens. It all starts at home!



COMPOST WORKS FOR YOU

Not only does composting help the environment, but it can help your garden, yard, and house plants too! When compost looks like soil and smells sweet and earthy, it is ready to use. Here are some of the most common ways to use compost:

IN THE GARDEN

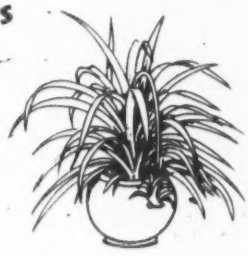


Before planting, mix a 4" to 8" layer of compost into newly reclaimed or poor soils. Mix a 1/2" to 3" layer of compost into annual garden beds at least once a year. Compost will add nutrients and beneficial microbes, hold water, and improve plant growth.

AROUND THE YARD

Spread a 1" to 6" layer of coarse compost on soil as a mulch, or spread a 1/2" layer of sifted, weed-seed-free compost on turfgrass as a topdressing. These can be done any time of year to improve soil fertility and reduce watering needs.

ON HOUSE PLANTS



Sprinkle a thin layer of compost over house-plant soil to provide nutrients. You can also make a great potting soil by mixing one part compost with two parts sand and/or soil.

DON'T HAVE A GARDEN?

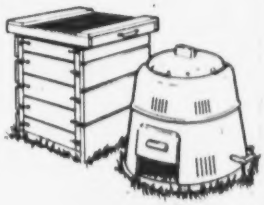
You can still make compost and use it on a house plant, give it to a friend, sprinkle it around a street tree, or use it in a community garden.

CHOOSE A SYSTEM

SYSTEMS FOR FOOD & YARD TRIMMINGS

RODENT-RESISTANT BINS

- For fruit, vegetable & yard trimmings (using "Mixed" compost recipe)
- For yard trimmings alone (using "No-Fuss" recipe)
- Bins require a lid, floor, & no holes bigger than 1/4"



OPEN PILES & SIMPLE BINS

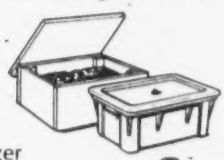
- For yard trimmings ONLY
- Requires "Active" composting (chopping & weekly turning to keep animals out)
- Usually inexpensive or free

SYSTEMS FOR JUST FOOD TRIMMINGS

For more information about the following, see the *Composting Fruit & Vegetable Trimmings* brochure.

Worm Bins

- Most fun! Takes some time & effort
- For indoors or outdoors
- Produces excellent fertilizer

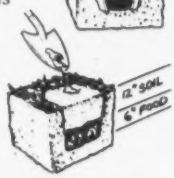


Closed-Air Systems

- Low maintenance
- Prone to odor & insect problems

Underground Composting

- Requires digging a hole each time you add new materials
- No harvesting necessary



REMEMBER . . . Whenever you compost fruit & vegetable trimmings, the Health Department requires a rodent-resistant system. Use a container with a lid, a floor, and no holes bigger than 1/4 inch, or bury food scraps at least one foot under the soil surface. For more information about bins, see the *Compost Bins – Sources & Designs* brochure.

FOLLOW THE BASICS

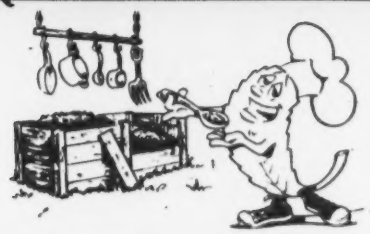
Thanks to friendly bugs and worms, composting is as easy as "1-2-3"— no matter which recipe you use!

1. **CHOP** materials if you want them to break down more quickly.
2. **MIX** "browns" (dry, woody materials) with "greens" (moist, green materials).
3. **MAINTAIN** air & water balance by keeping compost as moist as a wrung-out sponge.

Browns, Greens, Air & Water are the "big four" that will keep every compost pile happy.

	DO COMPOST:	DON'T COMPOST:
BROWNS	• Most sawdusts • Chopped, woody prunings • Pine needles • Fallen leaves	• Meat, bones or fish • Dairy products or grease • Grains, beans or breads • Dog, cat or bird feces • Sawdust from plywood/treated wood • Diseased plants (in cold piles) • Fruit & vegetable trimmings (in open piles/ simple bins)
GREENS	• Tea bags • Citrus rinds • Coffee grounds & filters • Lawn clippings & young weeds • Fruit & vegetable trimmings • Herbivore manures	

HOT COMPOST HAPPENS when you follow the basic "1-2-3" carefully, *and* the pile is about a cubic yard (3'x3'x3'). Heat can accelerate composting and kill weed seeds and plant diseases, *but is not necessary*. Cold, slow piles are just as good. If your pile is large enough, moist, and well chopped, but not heating up, you can turn it and mix in some greens like grass clippings or an organic nitrogen fertilizer. For faster hot composting and better weed-seed kill, turn or mix your hot pile about once a week.



RECIPES FOR RODENT-RESISTANT BINS

"NO-FUSS" COMPOST

For **yard trimmings** ONLY. Requires a rodent-resistant bin to prevent animal nesting.

INGREDIENTS:
Yard trimmings only (browns & greens), water as needed

DIRECTIONS:
Feed chopped or unchopped yard trimmings into bin as you generate them.

Maintain compost by keeping it as moist as a wrung-out sponge.

Harvest rich, brown, finished compost from the bottom and center of the pile after 12 to 18 months.

"MIXED" COMPOST

For **fruit, vegetable & yard trimmings** together. This recipe requires a rodent-resistant bin and active maintenance to prevent animal nesting and feeding.

INGREDIENTS:
Fruit, vegetable and yard trimmings (browns & greens), water as needed

DIRECTIONS:
Feed yard trimmings to your pile as you generate them by chopping them first into pieces 6" or smaller. Food scraps need to be buried and mixed into the center of the pile. Never dump and run! Be sure to mix in enough browns to balance your greens. Feed as often as you like.

Maintain compost by turning or mixing it about once a week. Keep it moist as a wrung-out sponge.

Harvest rich, brown, finished compost by sifting out coarse, unfinished materials after 3 to 8 months.

A RECIPE FOR OPEN PILES

"ACTIVE" COMPOST

For **yard trimmings** ONLY. In open piles & simple bins, active maintenance prevents animal nesting.

INGREDIENTS:
Yard trimmings only (browns & greens), water as needed

DIRECTIONS:
Feed yard trimmings to your compost by chopping them first into pieces 6" or smaller, then mixing them into the pile. Feed as often as you like. Be sure to balance browns with greens.

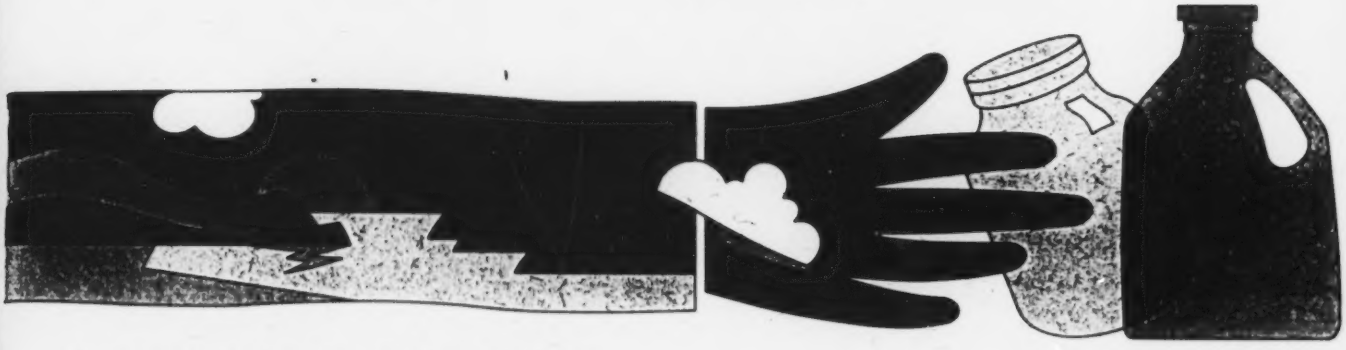
Maintain pile by turning or mixing it about once a week. Keep it as moist as a wrung-out sponge. Covering it with a plastic tarp will help keep it moist.

Harvest rich, brown, finished compost by sifting out coarse, unfinished materials after 3 to 8 months.

TROUBLESHOOTING

SYMPTOMS	PROBLEMS	SOLUTIONS
Pile not composting	Too dry	Add water untill slightly damp & turn (mix)
	Too much brown matter	Add fresh green matter or organic nitrogen fertilizer & turn
Pile smells rotten/ attracts flies	Too wet/ too many food scraps or lawn clippings	Turn & add browns (dry, woody materials) or dry soil
	Food scraps exposed	Bury & mix food scraps into pile
	Non-compostables	Remove meat, dairy, grease, etc. & turn
Rodents in pile	Food scraps in open bin/ holes larger than 1/4 inch/non-compostables	Use traps or baits, rodent-proof bin, remove meat, grease, etc. & turn

Environmental Shopping Guide



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This guide will show you how to use your buying power to help save our natural resources, reduce waste and litter, and extend the life of our landfills. That's a lot of power for your purchase!

You can make environmentally smart consumer choices the same way you make selections on price, quality, and nutrient value for foods —by comparing the various items on the shelf.

Because environmental shopping is a relatively new phenomenon, few products or packages have been labeled with enough information to help you make your decision. Several environmental groups are pushing for national standards. Until this is accomplished, try to choose the product that seems best for the environment, given the facts that you have. If you're confused about which is the proper packaging to buy, remember it's always right to choose the product that is packaged in recyclable or reusable materials.

It's also important for you to inform manufacturers and your local store managers of your packaging and environmental product preferences. As their customer, they're interested in what you have to say.

This booklet is designed to get you started. We hope you'll take it from here. The next time your hand reaches out for something on the shelf, make the choice that's right for the environment.

- ***In the six years since the non-recyclable brick packs of fruit drinks came on the market, more than four BILLION were sold and discarded—never to be used again.***

2. Minimal packaging.

The next best thing to look for after no packaging is the least packaging possible to protect or display the product. Here are some examples:

- Products that are not excessively packaged.
- One material packaging, rather than a combination of materials. Choose a plain cardboard box over a cardboard box with a plastic wrapper.
- Household products, such as utensils, stapled to a cardboard backing rather than shrink-wrapped over cardboard.
- Nylons packaged in cardboard, rather than plastic egg shapes or bags.
- Deodorant containers without cardboard wrapping.
- Concentrates, like juices and laundry detergents, which can be mixed with water at home for volume, rather than purchased in pre-mixed cartons and plastic jugs.
- Products which pre-mix combined uses into one package, such as laundry detergent and bleach in one box, shampoo and conditioner in one bottle.

Every time you consider a purchase, put its package to this test: Is there more material in the packaging than necessary to protect or display the product? Is the package made with more than one material? Compare similar items on the shelf and select the one with the simplest packaging.

3. Reusable and refillable packaging.

You can extend the life of a product container by looking for packaging that can be reused or refilled. This may be where plastic has its proper place. Because plastic is durable, it can be used repeatedly without wearing out. (The fact that it is so durable is exactly the same reason why it's silly to buy disposable products made of plastic.) If you buy a plastic container, see if there's a way you can reuse it. If you have a drawerful of plastic bags, bring them to the store with you to pack loose fruits and vegetables or purchases from the bulk shelf.

- Glass jars can be used for storing leftovers.
- Coffee cans with lids can double as cookie jars.
- Plastic or cardboard cottage cheese containers are great for storing small, loose items like nails and buttons.
- Some stores are now encouraging customers to return their container for refills—and will give you a discount if you do. Current refillable trends include lotions, shampoos, coffee bags, and of course, grocery bags.

Check the shelf for packaging that you can reuse or refill. Then remember to reuse or refill it.

4. Recyclable packaging.

Studies show that among people who don't recycle, the main reason for not recycling is that they don't think they can save enough to make a difference. But consider this:

- ***The energy saved by recycling one aluminum can is enough to keep a 100-watt light bulb burning for four hours.***
- ***The energy saved by recycling one glass jar will operate a television set for three hours.***
- ***One person uses and discards two pine trees in paper products each year.***

When you buy and recycle products in recyclable packaging, you are playing a big role in saving natural resources, such as bauxite for producing aluminum, silica for glass, and petroleum for plastics. You will also help save water, gas and oil which are used in production of all new materials.

All San Francisco residents will have curbside recycling service by mid-1991. The City also has numerous recycling buy-back and community drop-off centers. Listed on the next page are items that will be accepted by the curbside collection program and many of the centers.

- Aluminum cans
- Glass jars and bottles
- Plastic PET soda bottles*
- Tin and steel cans
- Cereal and other dry food boxes
- Flattened cardboard
- Junk mail
- Magazines and telephone books
- Newspaper
- Office and other paper
- Paper bags

*In San Francisco, only one kind of plastic is currently recyclable—plastic soda containers. That's why we recommend paper or glass over plastic packaging whenever possible.

Make a point to remember the materials that can be recycled in San Francisco. Purchase products packaged in those materials. Be sure to complete the cycle by recycling them!

5. Packaging from recycled materials.

- *Every ton of paper produced from waste paper uses half the water and energy and results in 74% less air pollution and 35% less water pollution, than paper made from virgin materials.*
- *Paper takes up close to 50% of the landfill space in the U.S.*
- *Five million tons of office paper is thrown away every year in the U.S.*

Most of us have heard stories about cities that could not sell the paper and other materials collected in their recycling programs. Thus far, San Francisco has been successful in selling the materials collected in its recycling programs. But unless individuals buy recycled products, San Francisco may not continue to be so fortunate. By buying recycled materials, you help complete the "cycle" of recycling and create a use for the glass, aluminum, paper and other materials collected in recycling programs.

- Look for the familiar Recycle logo that indicates the package is made from recycled materials.
- Recycled cardboard for cereal, detergents, and other packaging boxes can be identified by the gray color (rather than white or brown) on the inside of the package.
- Buy stationery, greeting cards, writing tablets and other paper products made from recycled paper. Recycled paper is just as good or even better than non-recycled paper, according to commercial printing experts.

Environmental Options

Look for the familiar Recycle logo *or a "Made from recycled materials" statement on packaging. Let store managers and manufacturers know that you would like the recycled materials label on packaging.*

Pre-measured coffee filter packs. *Unnecessary packaging.*	Coffee in tin cans. Reusable filters.
Soft soap in plastic containers. *Unnecessary packaging. Rigid plastic takes up landfill space.*	Bar soap in paper wrapping.
Add-water-and-shake-pancake mix in throw-away plastic container. *Can only be used once.*	Instant pancake mixes in cardboard box.
Individual juice packs. *Non-recyclable multi-material packaging.*	Juice in recyclable glass bottles or tin cans.
Products in "blister packs" with cardboard backing, such as hardware tools. *Unnecessary packaging.*	Unpackaged products or packaged ONLY in cardboard.

Products come in more than one kind of packaging. Listed below are examples of those packaged in the most environmentally-sound materials.

Sugar and flour in bulk sacks.

Compact fluorescent light bulbs in corrugated cardboard packaging.

Mouth wash in glass bottles.

Baking soda in a cardboard box.

Powdered detergent.

Cardboard egg cartons.

Milk in glass containers.

Any unpackaged product.

- ***One man could use and discard 3,500 disposable razors in a lifetime.***
- ***Fluorescent lights are 3 to 4 times more efficient than standard (incandescent) bulbs and last 8 to 15 times longer. By using fluorescent lights rather than the incandescents, approximately $100 can be saved over 20,000 usage hours.***
- ***In the 1988 California Coastal Cleanup, almost 50% of the total garbage collected was plastic.***
- ***Batteries comprise approximately .05%, by weight, of the U.S. waste-stream, but account for over 50% of the mercury and cadmium found in the waste.***

- *Americans buy and throw away 500 million disposable cigarette lighters every year.*

In addition to thinking about packaging, you might also want to consider the environmental impact of the product in the package.

1. Buy only what you need.

There's no better way to reduce waste than to buy less to throw away in the first place. When you shop, ask yourself if you really need the item you're buying. Buy it in bulk, if it won't spoil or if you'll eventually use it. But if not, buy less. If you need it, how much of it do you need? You'll help stretch your budget and our landfill space.

2. Think durable not disposable.

Who would have thought consumers would actually buy products that aren't meant to last? Yet manufacturers have found a goldmine in marketing disposable and short-life products to Americans. Our environment suffers in the long run for the sake of our short-lived convenience.

It's up to you, as a consumer, to turn this situation around. Manufacturers respond to demand. By switching from disposable products to their durable, long-lasting counterparts, you will send a message to manufacturers that American consumers expect quality and respect the environment.

When you buy a product, ask yourself how long it will last in your home compared to how long it will last in our landfill.

- *Buy rechargeable batteries.*
- *Buy razors with replaceable blades instead of fully disposable ones.*
- *Buy refillable pens, pencils and lighters.*
- *Choose cloth diapers over disposable or biodegradable diapers, particularly for use at home. Most diaper services are less expensive than throw-aways.*

- *When making a major purchase, such as appliances, check Consumer Report magazine for the best quality and most energy-efficient brands.*
- *Write the manufacturer if a product breaks quickly, or fails to meet promised quality standards.*
- *Buy reusable plastic plates, cups, and silverware for picnics. Take them back home with you to be washed and used again later.*

Make a commitment to switch from disposable to durable products. Before you buy, ask yourself if the convenience of the product justifies its environmental impact. Protect marine life—don't litter our beaches with plastics.

Don't buy things you don't need. Don't buy more than you'll use.

- *If you must use disposable plates, purchase ones made from recycled paper.*
- *Shop for items which can be repaired rather than disposed of when they break.*

3. Shop for a safer environment.

This booklet has concentrated on the wasteful environmental effects of packaging and products on our natural resources and landfills. If you would like to learn about shopping for environmentally SAFE products, such as alternatives to household cleaning chemicals, call the San Francisco Household Hazardous Waste Hotline at 554-4333 for a free guide.

You, as a teenager, also have an important role in taking care of our environment. Every little thing you do counts for a lot when you add it all up. You'll get more out of it if you can get your friends to pitch in, too.

- Buy recycled paper for school notebooks and as filler paper.
- Use refillable pens and pencils.
- Use the other side of tests, homework, assignments, etc. for scratch paper.
- In a fast-food restaurant, ask for paper wrapping instead of styrofoam containers. "Hold the styro, please!"

- Hold a swap party with friends and relatives for clothes and other things that you don't use any more.
- Read the section on packaging in this guide, so that next time you shop for yourself or for your parents, you can shop for the environment as well.
- Start a recycling program among your friends or at school.
- Ask your school principal to purchase durable, recyclable and recycled supplies.
- In self-service soda or coffee stations, choose paper over plastic or styrofoam cups—better yet, carry your own cup or thermos in your backpack.
- If you buy ice cream or frozen yogurt and can choose between cup or cone, ask for cone. It's more fun to eat and you can eat the package, too! If you want a cup, ask for paper instead of styrofoam.
- Some of the best fashion finds are in thrift shops, like vintage clothes and interesting jewelry.

You, too, can join in helping our environment by doing your own important part. Here are some things you can do easily.

- Take care of your toys. If you do not want them anymore, pass them on to your friends or you can ask your mom to let you have a toy exchanging party with your friends and playmates.
- When you are in a store, look for loose toys that are in bins instead of those in boxes with see-through plastic windows.
- Buy snack foods, such as raisins, nuts, and candy in bulk jars instead of those that are already packaged in plastic.
- Take your lunch in a lunch box to school. Use a reusable sandwich box for your favorite sandwich. By the time you finish high school, you would have saved 3,400 bags.
- Bring your favorite juice in a thermos to school and start a new trend. A lot of kids like bringing juice packs, but their containers cannot be used again or recycled. They need about 300 to 400 hundred years to disappear, and there are about 4 billion of them now in the garbage dumps!
- If your favorite toy comes in too much packaging, write a letter to the toy company!
- Make sure you put your recyclables in your recycling bin at home. If you don't have one, help your parents set up recycling at home.

Check out check list.

While you're waiting in the check out line, check out your purchases one more time. The first few times you try this, you might be surprised at how some of your "automatic" purchases don't meet your environmental shopping goals.

DID YOU:

- *Buy only what you need?*
- *Pick the economy size of items you use frequently?*
- *Select products with the least packaging?*
- *Find anything without a package?*
- *Buy items in bulk bins?*
- *Choose recyclable packaging over non-recyclables?*
- *Find containers that can be refilled or reused?*
- *Bring your own bag(s)?*
- *Talk to the store manager about your preferences?*

PAPER OR PLASTIC BAGS?

It's not always a clear-cut choice, but in San Francisco, where litter from plastics is especially dangerous to marine animals and seabirds, we think paper is the better choice. The best choice is to bring your own cloth or canvas bag. (Or, for single items, maybe you don't need a bag at all.) You can reuse your own plastic bags for produce and bulk items. Also, we recommend that you avoid "degradable" plastics until more is known about some of the problems associated with them, such as their potential toxicity.

Other ways to help the environment.

Start Recycling

By mid-1991, all residents in San Francisco will have curbside recycling collection service; but throughout the city, even today, you can recycle at our many community centers. Call 554-6193 for your free copy of the following:

- *Recycling Starter Kit and list of recycling centers*
- *Office Paper Recycling Guide**
- *School (K-5) Recycling Curriculum**
- *Restaurant Recycling Guide*
- *Making Recycled Paper at home*
- *Environmentally Sound Products Guide*

Consider Composting

Composting yard and food waste can reduce household garbage by as much as 15-20%!

Call the San Francisco League of Urban Gardeners (SLUG) at 468-0110 for a free composting guide.

Know What's Safe

You can minimize potential hazards to your health and to the environment by buying safety-smart products and disposing of them safely and responsibly. Call 554-4333 for a free copy of:

- *Garbage Cans & Garbage Can'ts: Household Hazardous Waste Guide*

* *Charge for residents and businesses outside of San Francisco*

The City and County of San Francisco's Programs for Pollution Prevention.

The City and County of San Francisco has three departments which assist households with the disposal of toxic wastes generated within the home: the Department of Public Works, the Solid Waste Management Program and the Department of Public Health.

The Department of Public Works administers programs for residents, businesses and schools to reduce the amount of toxic products discharged into the City's combined sewer system.

The Solid Waste Management Program sponsors the Household Hazardous Waste Collection Facility, where residents can dispose of their unwanted toxic products, and the curbside recycling program.

The Department of Public Health, Bureau of Toxics, Health and Safety Services answers questions and sends out information about such problems as: asbestos, indoor air pollution and lead. The Bureau is also responsible for the enforcement of hazardous waste and materials regulations.

Join the City in it's efforts to prevent pollution. By participating in the City's programs, you will be properly disposing of your wastes and helping to protect the environment.

This brochure was reprinted by permission of the Santa Clara Valley Nonpoint Source Pollution Control Program. Design and Illustrations by John Finger.

For More Information on Pollution Prevention, Call:

Department of Public Works Bureau of Environmental Regulation and Management	695-7310
Department of Public Health Toxics, Health and Safety Services	554-2780
Household Hazardous Waste Program	554-4333
Recycling Program	554-6193

To Report Illegal Dumping of Hazardous Materials or Wastes to the Storm Drain or Sewer System, Call 695-2020.

San Francisco Department of Public Works

BEST COPY AVAILABLE

Printed on Recycled Paper

Water Pollution Begins in Your Home!

A Guide to Protecting the San Francisco Bay and Pacific Ocean.

Can You Find the Activities that Contribute Pollution to the San Francisco Bay and Pacific Ocean?

The picture above shows how products related to our daily lives "go down the drain".

You can help minimize pollutants from entering the Bay and Ocean by following some of the suggestions below.

Household and Home Maintenance

Buy household products such as cleaners and furniture polish labeled "non-toxic". Use small quantities and purchase only the amount you need.

Properly use and store all hazardous products, including cleaners, solvents and paints. Keep products covered at all times.

Take unwanted household hazardous products to the Household Hazardous Waste Collection Facility.

Use kitty litter or other absorbent material to clean spills from paved surfaces. Depending on the substance, dispose of absorbents in the garbage or at the Household Hazardous Waste Collection Facility.

Refrigerate used paint brushes between uses. Upon completion of a project, remove all paint from brushes and then rinse. Filter and reuse brush cleaners. Dispose of all paint related products at the Household Hazardous Waste Collection Facility.

Use blue bins for recyclable materials. Throw litter into trash cans and keep them tightly covered to prevent foraging by neighborhood animals.

Prevent dirt and debris at construction sites around the home from entering storm drains by covering, wetting down or planting drought resistant ground cover.

Lawn and Garden

Use pesticides, herbicides and fertilizers carefully and sparingly in accordance with label instructions. Do not apply if rain is forecast. Take unwanted products to the Household Hazardous Waste Collection Facility.

Use a rake or broom rather than a hose to clean up garden clippings. Deposit leaves and clippings in a compost pile or garbage can.

Divert rain spouts and garden hoses from paved surfaces onto grass to allow filtration through the soil. Water only your lawn and garden.

Pick up animal waste and flush the waste down the toilet or dispose of it in a plastic bag in the garbage.

Automotive

Take used motor oil and antifreeze to the Household Hazardous Waste Collection Facility. For a recycling location closer to you, contact the Hazardous Waste Program.

Have your car inspected and maintained regularly to reduce leakage of oil, anti-freeze and other fluids.

Reduce automotive emissions through regular auto maintenance, ride sharing and by using public transportation.

Conserve water when washing your car and use biodegradable soap.

You can protect the San Francisco Bay and Pacific Ocean by taking all unwanted household hazardous products to the Household Hazardous Waste Collection Facility.

Because most people don't realize they are contributing to polluting the Bay and Ocean, spread the word and get your neighbors and co-workers involved.

Together, you and your neighbors can make a difference in keeping the Bay and Ocean clean and healthy for fish, birds, wildlife and ourselves.

San Francisco Department of Public Works

Did you know that dumping one quart of motor oil in the water can contaminate 250,000 gallons of water?

San Francisco's sewer system collects both street runoff and wastewater from residents, businesses and industry. This combined system delivers storm water and wastewater to one of the City's three wastewater pollution control plants for treatment and ultimate discharge to the San Francisco Bay or Pacific Ocean.

When products which contain heavy metals (such as used motor oil and paints) are flushed down the toilets, poured into the sink or discharged into the storm drain, those metals can only be partially removed by the wastewater treatment facilities. What is not removed ends up in the San Francisco Bay and the Pacific Ocean. Heavy metals are toxic to fish, marine animals, birds and other wildlife.

How You Can Help

With very little effort we can change our buying and disposal practices for our most commonly used products, and gradually adopt a less destructive lifestyle. Making peace with the environment can be easy and doesn't take too much time.

You can help to prevent pollution of the Bay and Ocean by becoming a responsible consumer.

- ❒ Avoid the purchase of products that contain metals or other toxic compounds by selecting safe, convenient alternatives. (Call the Household Hazardous Waste Program for a free guide to less-toxic shopping.)
- ❒ Purchase the right amount of products to avoid having "leftovers".
- ❒ Give unavoidable "leftovers" to a neighbor or group that can use them.
- ❒ Always store all products in their original containers in order to have instructions on use available.

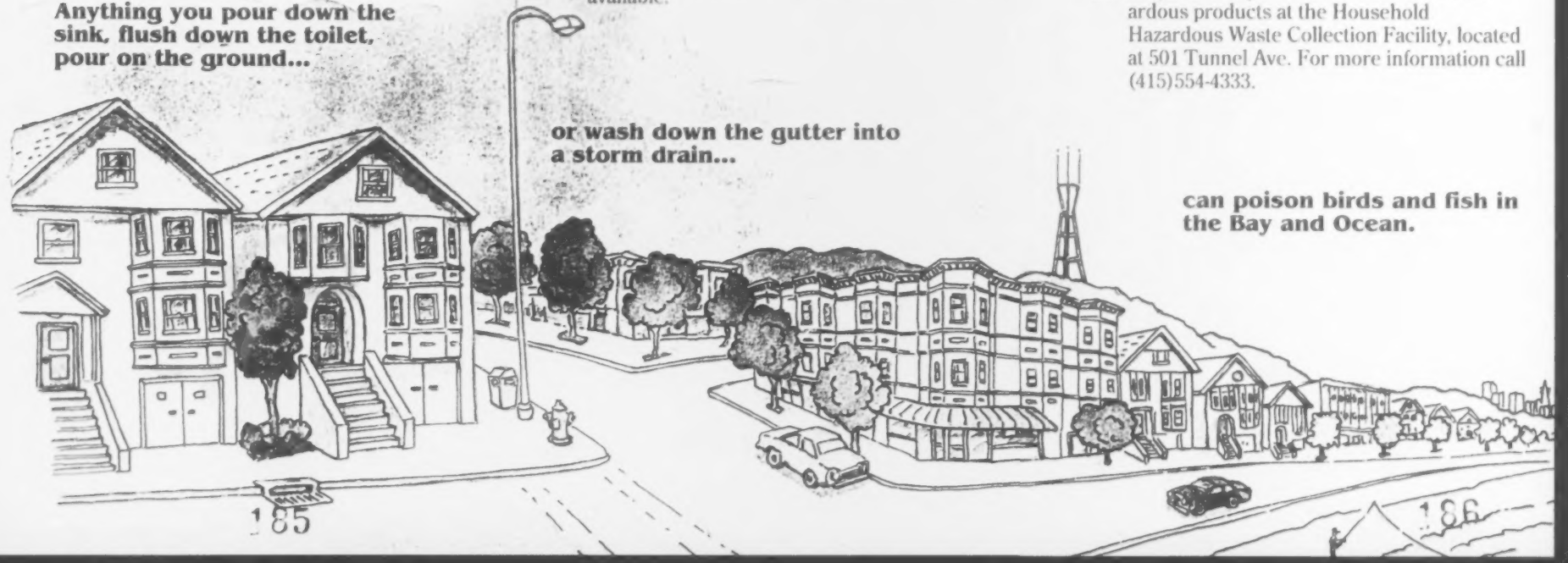
How you use and dispose of products which contain toxic substances has a direct impact on the environment and our quality of life.

- ❒ Follow product instructions carefully and never mix products.
- ❒ Never pour toxic materials on the land or into the storm drain. Eventually waste handled in this way will pollute the Bay or Ocean.
- ❒ Recycle as many liquid products as you can, such as used motor oil and latex paint.
- ❒ Recycle product containers, such as glass jars, cans, bottles, paper and cardboard.
- ❒ Remember to buy recycled products, to "close the loop" and fully support the recycling effort.
- ❒ Dispose of any unwanted household hazardous products at the Household Hazardous Waste Collection Facility, located at 501 Tunnel Ave. For more information call (415)554-4333.

Anything you pour down the sink, flush down the toilet, pour on the ground...

or wash down the gutter into a storm drain...

can poison birds and fish in the Bay and Ocean.



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